

**PHASE 2 REPORT - REVIEW COPY
FURTHER SITE CHARACTERIZATION AND ANALYSIS
DATABASE REPORT
HUDSON RIVER PCBs REASSESSMENT RI/FS**

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**ALTERNATIVE REMEDIAL CONTRACTING STRATEGY (ARCS)
FOR
HAZARDOUS WASTE REMEDIAL SERVICES**

EPA Contract No. 68-S9-2001

VOLUME 2A

TAMS CONSULTANTS, Inc.

and

Gradient Corporation

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VOLUME 2A - DATABASE REPORT
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EXECUTIVE SUMMARY

The Phase 2 Database Report describes the organization of the data collected for the Hudson River PCBs Reassessment including both historical data, Phase 2 project data and recent data collected by others. This Database Report is Volume 2A and addresses only the Hudson River Reassessment database, its structure, and use. There are five additional reports (Volumes 2B through 2F) which will be issued in Phase 2.

The report contains two main sections, specifically:

- **Database Overview** section which defines the database elements, explains the sources of data, describes the organization of the data within the database itself, and discusses the contents of each of the seven major database directories and their subdirectories.
- **Database User's Guide** section which explains in considerable detail what specific data are located in which directory, subdirectory or table and provides (using examples from the actual database) practical examples of common queries and applications.

Approximately 750,000 records reside in this Reassessment database. The database is organized into over 100 database tables and spreadsheets. The entire data set is available from USEPA in DOS-compatible format on CD-ROM, a "read-only" (*i.e.*, the data can only be viewed) compact disk which looks exactly like an ordinary audio CD but is formatted for use by computer according to standards for computer data organization. The database on CD-ROM will be in two database formats, Paradox™4.0 and FoxPro™/dBase III™.

The database is a combination of historical data collected prior to this Reassessment and field data gathered during Phase 2 of the Reassessment, from sampling programs conducted by USEPA and from complementary programs performed by other investigators (*e.g.*, GE, NOAA, etc.) which are relevant to this project. There are seven major directories in the database: *HISTORIC*, *LDEO*, *USGS*, *GE*, *NYSDOT*, *PHASE 2* and *NOAA*. Each of these main directories are described more fully in the Report. Figure ES-1 represents an overview schematic of the Reassessment database structure showing the major directories and subdirectories and a general description of the directory contents.

The database created for the Reassessment provides the foundation for all studies to be performed by the USEPA for the Reassessment RI/FS.

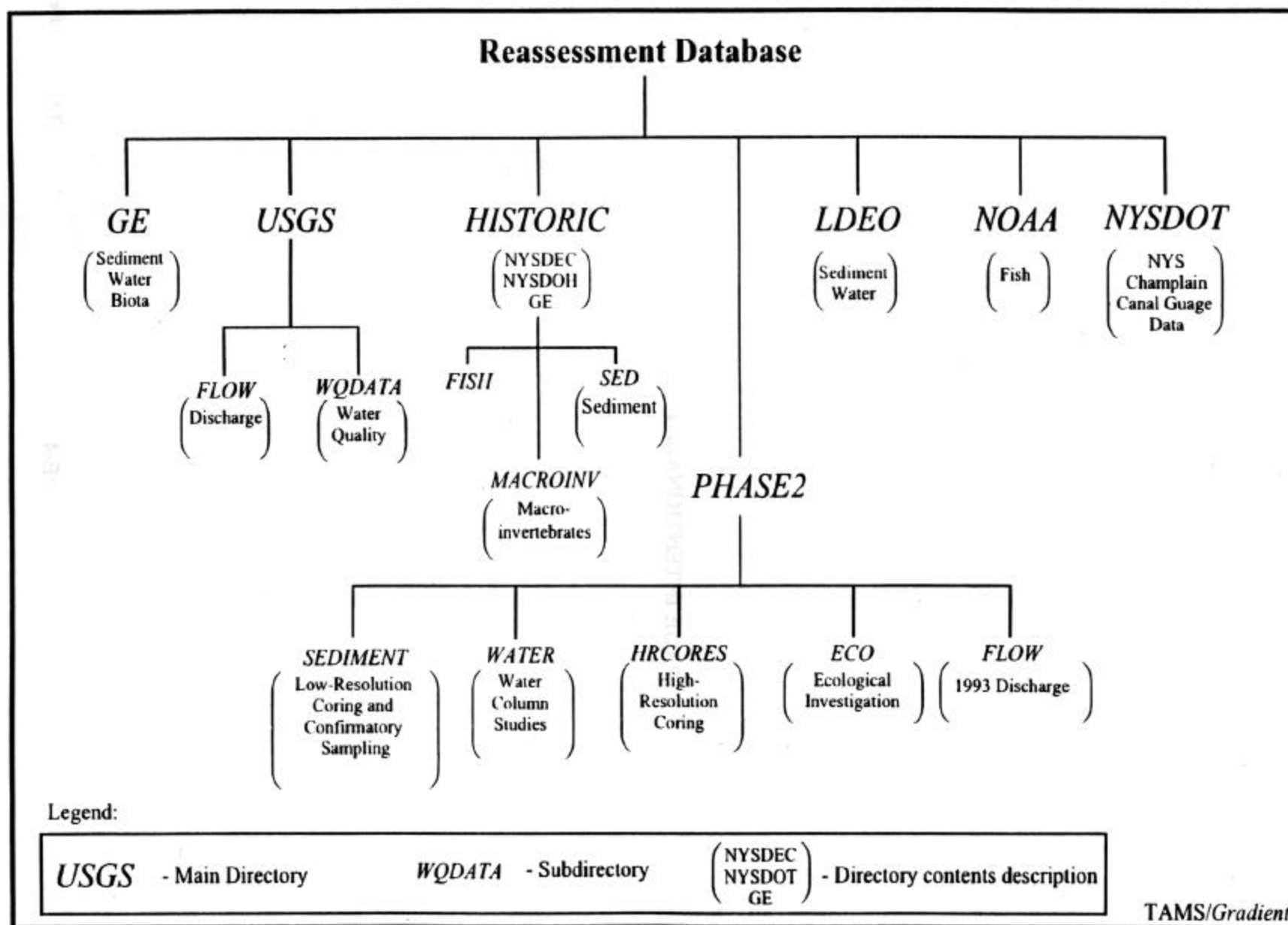


Figure ES-1
Descriptive Diagram of the Hudson River PCB Reassessment Database

1. INTRODUCTION

This document provides a description and guide to the extensive database created for the Hudson River PCBs Reassessment Remedial Investigation/Feasibility Study (RI/FS). The database contains information obtained from a variety of sources: New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), New York State Department of Transportation (NYSDOT), General Electric Company (GE), the Lamont-Doherty Earth Observatory (LDEO), the United States Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), as well as the United States Environmental Protection Agency (USEPA).

In December 1990 USEPA issued a Scope of Work for reassessing the 1984 No Action decision for the Hudson River PCB site which identified the three phases as follows:

- Phase 1 - Interim Characterization and Evaluation
- Phase 2 - Further Site Characterization and Analysis
- Phase 3 - Feasibility Study

The Phase 1 Report is Volume 1 of the Reassessment documentation and was issued by USEPA in August 1991. It contains a compendium of background material, discussion of findings where findings could be made and preliminary assessment of risks. The TAMS/Gradient team compiled a database of historical data to complete the Phase 1 work. The database issued with this report represents an expansion of the previous compilation due to a plethora of new data collected or researched since the earlier work was performed. This database provides the most comprehensive data set available to date for investigating PCBs in the Hudson River.

This Database Report is Volume 2A of the Reassessment documentation and is one of a series of reports in Phase 2. Companion Phase 2 documents are planned to include the Preliminary Model Calibration Report (PCB fate and transport modeling), the Data Evaluation and Interpretation Report (results of the Phase 2 investigations), Baseline Modeling Report (baseline models used in the ecological and human health risk assessments), the Human Health Risk Assessment Report and the Ecological Risk Assessment Report.

This Database Report includes two chapters following this brief introduction, summarizing the contents of the database and its sources (Chapter 2) and directing the data users through specific example queries and pertinent database details (Chapter 3). To facilitate widespread and relatively easy use of the data set itself, this report contains details of database design including listing of database tables, names and descriptions of fields and relationships between database elements. Additional tables of information are included as glossary tables within the database itself to also assist the user. The data set itself is considered part of this report and is available on CD-ROM in DOS-compatible format from the USEPA.

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It should be noted that the inclusion of non-USEPA data in the data set does not constitute any approval, validation or certification of the data by the USEPA. Since these data were not produced specifically for the USEPA, the USEPA cannot be responsible for any errors they contain. Users of the non-USEPA data tables should refer to the original documents containing these data for clarification of data quality and potential uses. In some cases, the user will need to refer to the original documents for specific information concerning sample locations and descriptions. The non-USEPA data provided in the database were reviewed and used as needed in this Reassessment, and are included in the database for completeness.

2. DATABASE OVERVIEW

In simplest terms, a database is an organized collection of information. The classic example of a database is the telephone book which organizes information about people: names, phone numbers, and addresses. A *relational database* arranges distinct categories of information into *tables* where data are accumulated as rows or *records* in columns or *fields*. Relationships or *links* between fields are explicitly defined so that information may be drawn from multiple tables. Data dictionaries defining the names and sizes of table fields are provided for all database tables. The database elements are summarized below.

- **Relational Database**
Collection of computer files that store data in the form of tables
- **Record**
Row in a database table
- **Field**
Column in a database table
- **Links**
Relationships between database tables based on common fields (columns)
- **Data Dictionary**
Table that defines data table fields
- **Data Glossary**
Computer file that contains the definitions of parameters and terms used in the database

TAMS/Gradient has used the relational model in developing the Hudson River database. Because of the quantity of information, the Hudson River database is organized by sampling program and by environmental medium. The database tables are organized into several basic elements, including chemical concentration data, sampling information, and reference information. The basic elements may be composed of many tables that are linked together. The organization provides a means for efficient data management.

The extensive size of the database is dictated by the large number of monitoring efforts which have taken place in the Hudson. During the early 1970s, NYSDEC and several other agencies began the first comprehensive monitoring studies for PCBs in the Upper Hudson. Fish, which were some of the earliest environmental samples analyzed, showed high concentrations of PCBs. These early investigations began over two decades of studies to date on PCBs in water, sediments, fish and other media affected by PCB discharges to the Upper Hudson. Table 2-1

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summarizes the major investigations.

Of the many investigations listed in Table 2-1, nearly all are represented in some fashion in the Reassessment database. In general, only those data which were explicitly used in the Reassessment were included in the database. Thus, not every dataset represented in Table 2-1 is included in its entirety in the Reassessment database. Nonetheless, the non-Phase 2 data contained in the database represent more than 400,000 of approximately 750,000 records in the Reassessment database.

Figure 2-1 shows the seven major directories for the Reassessment database. Also shown are the subdirectories for each of the major directories. This figure provides descriptive titles of the directories along with some notation concerning the agency or type of data contained in the directory. For those readers who are unfamiliar with computer terminology, a directory is similar to a filing cabinet. Subdirectories, in turn, are similar to the individual drawers of the cabinet, which contain the individual files (or tables) in the database. The report maintains certain conventions when referring to specific database elements. When a file directory or subdirectory is noted in the text, it is in italics and capital letters, *e.g.*, *HISTORIC\SED*. Database table names are in capital letters and bolded, *e.g.*, **STATIONS**. Database fields are in bold text and written as they appear in the tables, *e.g.*, **Yr** or **Ref**.

Figure 2-2 shows the Reassessment database structure in more detail, providing exact directory and subdirectory names as well as the names of all files contained in the database. Table 2-2 provides a summary of the data sets contained in the database and Table 2-3 describes the contents of the subdirectories for each of the seven major directories.

In the remaining portions of this chapter, the contents of each of the seven major directories along with their subdirectories are described. These descriptions provide the original source of the information contained in the Reassessment database as well as a general description of the data itself, including the number of samples and the types of analyses. These descriptions are not intended to address the quality or interpretation of these data. These discussions will be found in subsequent Phase 2 documents.

2.1 Historical Data

2.1.1 Sediment

This section reports on the data sets contained in the *HISTORIC\SED* subdirectory: the NYSDEC 1976-78 surveys, the 1984 NYSDEC Thompson Island Pool Sampling, and the 1989 and 1990 GE sediment sampling efforts. So that each record is explicitly classified in the database tables, the **Yr** and **Ref** fields identify the year the sample was collected and the data source, respectively. Data sources for the historical sediment component are shown in Table 2-3A. Unless otherwise noted, the data are organized within the main database tables of the *HISTORIC\SED* subdirectory.

1976-78 NYSDEC Sampling

As reported by Tofflemire and Quinn (1979), NYSDEC conducted several sediment sampling surveys in the Hudson River between 1976 and 1978. Details of the sampling and analysis procedures for these studies are summarized in NYSDEC Technical Report No. 56 (Tofflemire and Quinn, 1979).

The data provided to TAMS/Gradient by NYSDEC as printed results represent a total of 1,167 sediment samples, 396 core samples and 771 grab samples, collected during 1976, 1977, and 1978; 1,770 PCB analyses were reported for the 1,167 samples. The overwhelming majority of samples from the 1976-78 data set correspond to locations in the Upper Hudson River, *i.e.*, 1,091 of the 1,167 samples. Of the remaining samples, only five samples in this data set have locations recorded in the Lower Hudson River, and each of these five was from River Mile 153, just south of the Federal Dam at Troy. One anomalous sample was reported for River Mile 105.2; however, its northing value, 1,166,970 feet, corresponds to a location within the Upper Hudson River. A total of 70 samples had no information regarding river mile or northing-easting coordinates, and therefore could not be considered in subsequent data evaluation. Figure 2-4 shows the NYSDEC sampling locations.

TAMS/Gradient encountered some difficulty matching the contents of the database with the data summaries provided in the original data reports. The differences in the overall number of samples is detailed in the Phase 1 Report.

Aroclors 1016, 1221, and 1254 were identified as the PCB mixtures detected in the 1976-78 sediment sampling effort. Analytical quantitation limits were not reported in this data set, and no indication was given regarding whether a sample had detectable or nondetectable concentrations of PCBs. However, several concentrations (1 ppm, 5 ppm, 10 ppm) occur with great frequency, suggesting that these concentrations are probable quantitation limits for these samples.

1984 Thompson Island Pool Sampling

In 1984, NYSDEC undertook an extensive sediment sampling program in the Thompson Island Pool (Brown *et al.*, 1988). The objective of this study was to characterize areas of contaminated sediments that would be removed during the Hudson River PCB Reclamation Demonstration Project, focusing primarily on the 20 *hot spots* previously identified in the Thompson Island Pool and other areas with known or suspected high PCB concentrations.

The investigators identified 1,260 sampling locations in the approximately five-mile reach of the river from Thompson Island Dam north to Rogers Island (See Figure 2-5). Many of these locations were determined by imposing a 125-foot triangular grid on previously defined *hot spots* and on additional areas with isolated PCB concentrations in excess of 50 ppm during the 1983 USEPA survey (NUS, 1984). In addition, sample locations were selected based on known or suspected sediment depositional areas, as indicated by location in the river and bathymetric

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measurements. Sample locations in the field were determined electronically using a microwave locating system.

Samples for the NYSDEC survey were collected by Normandeau Associates, Inc. between August 24 and November 30, 1984. In addition, 21 cores were collected from February 1 through 4, 1985; these later samples were collected through ice on the river at locations that had been inaccessible by boat. Table 2-4 provides a description of these data along with a comparison to the results reported by Brown *et al.*, 1988. The database compiled and supplied by NYSDEC to the TAMS/Gradient team contains 2048 records, including duplicate samples and reanalyses. These data represent 408 individual coring sites and 675 grab sample sites (including two sites with no coordinates given). The database includes some 24 co-located resamples representing 23 grabs and one core, with identical site numbers but slightly different location coordinates. The database also contains an additional 35 grab samples and 25 core samples with duplicate analyses. Of the 35 grab samples, 29 appear to be duplicate analyses (*i.e.*, field duplicates with the same date and same location), while 6 pairs, taken on different days, appear to be resamples at an exact duplicate location. All the core duplicate samples represent duplicate analyses. Although this dataset was supplied by NYSDEC, it is somewhat larger than the results reported by Brown *et al.*, 1988. Brown *et al.* reported a total of 407 cores and 607 grab samples in their analyses. The small difference in the total number of cores reported apparently represents rejection of positioning data for one core at station 264. The reason for the larger discrepancy in the number of grab samples reported is unclear.

Samples with field duplicate analyses are labelled with a "D" in the **Dup** field of the **SAMPLES** database table. This "D" indicates that two analyses are available for the particular sample for PCBs and conventional parameters. In the **CONCSED**, **MASSPEC** and **NONCHEM** tables, the **Dup** field is used only to designate the second analysis in a pair of field duplicates. The first analysis in a duplicate pair will have a blank entry in the **Dup** field while the second will have identical **GradNo** and **Section** labels but will be labelled "D1" in the **Dup** field. **CONCSED** contains 53 duplicate pairs for the 1984 data while **NONCHEM** and **MASSPEC** contain 54 duplicate pairs.

As part of the 1984 sediment survey, NYSDOH and Versar, Inc. measured physical and chemical parameters of the sediments collected in this study. NYSDOH determined lengths of cores and sections, percent dry solids, dry specific weight (density), and textures (determined visually). Versar measured percent volatile solids and performed the gas chromatograph analyses for PCBs.

In this investigation, PCB concentrations were screened using gas chromatography with a mass spectrometer (GC/MS) and quantitated by gas chromatography with an electron capture detector (GC/ECD). The GC/MS analyses were used primarily as a screening method to determine which samples would be quantitated using the more accurate (and more expensive) GC/ECD analysis. The GC/MS screening classified samples into one of four categories of total PCB concentrations: less than 10 ppm (<COLD>), 10 to 50 ppm, 50 to 100 ppm, and greater than 100 ppm (*HOT*). Most samples screened into the higher categories were analyzed further using

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the GC/ECD method; conversely, many samples that exhibited low PCB concentrations by GC/MS were not quantitated by GC/ECD. Additional information on the screening levels can be found in *HISTORIC\SED\NONDETS* file.

Versar quantitated PCBs as Aroclors 1242, 1254, and 1260 using the method of Webb and McCall (1973). Although the data received from NYSDEC contained a "total PCB" quantification, no mention is made in Brown *et al.* (1988) of the method used to quantify, or calculate, this total. Examination of the data received indicates that the total was not simply the sum of the three Aroclor mixtures quantitated.

The database supplied by NYSDEC contains a total of 926 GC-ECD analyses for PCBs, slightly less than the 954 reported by Brown *et al.* as shown in Table 2-4. The database also contains a record of 1536 samples screened by mass spectrometry. This is greater than the 1125 samples reported by Brown *et al.*, and likely reflects the presence of additional grab samples. A total of 497 samples were reported as analyzed by both GC/ECD and GC/MS and mass spectrometry in the database, matching the number reported by Brown *et al.*

GE 1989 Baseline Studies for the Remnant Deposit Containment Project

As part of the Remnant Deposit Containment Project, General Electric, with USEPA oversight, conducted baseline pre-remediation sediment monitoring (other related monitoring efforts are discussed for the affected media). Sediment samples were collected at five locations in the vicinity of the remnant deposits: one location near Rogers Island; one location far upstream; one location between the remnant deposits and Bakers Falls; and two downstream locations near Lock 6 and Waterford. With the exception of samples from the two downstream locations, PCBs were detected in all samples. The chromatograms were compared against Aroclor mixtures 1221, 1232, 1016, 1242, 1248, 1254, and 1260; Aroclor mixtures detected in the samples were reported to be a construction of Aroclors 1242 and 1254. Because these earlier data were only quantitated on an Aroclor basis and were not validated by GE and its subcontractors, they are considered by GE to be of lower quality than later data. Subsequent GE PCB analyses were validated by GE and also provided more analytical detail including, for example, quantitation of homologue groups. As a result, the 1989 study data were provided separately from other data files by GE. Maintaining this distinction, the 1989 sample records are not contained in the main database tables in the *HISTORIC\SED* subdirectory. Instead, these data reside in a table called **GE89** in the same *HISTORIC\SED* subdirectory.

GE 1990 Sediment Sampling for Bioremediation Investigations

General Electric has been conducting extensive research on biological dechlorination and degradation processes occurring within the river which may have altered the composition of the PCB Aroclor patterns within the sediments. In conjunction with these studies, GE has collected samples from selected areas of the Upper Hudson for more detailed evaluation. General Electric provided USEPA with preliminary results of their sediment sampling activities during a meeting on February 28, 1991, and confirmed by a letter dated March 8, 1991 (Claussen, 1991).

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In this effort, Harza Engineering collected 103 cores from 12 *hot spots* during 1990 and reported 275 PCB analyses. From three to eight cores were collected at most locations, with the exception of GE's "H-7" location where 62 cores on a 12-foot by 12-foot grid were collected. Samples were analyzed for PCB homologue groups and for five Aroclors, *i.e.*, 1221, 1242, 1254, 1260, and 1268. These results are included in the sediment portion of the historical database and are identified as being from Harza by the entry in the **Agency** field of the **GRADNUMS** database table.

Lamont-Doherty Geological Observatory Investigation

The Lamont-Doherty Geological Observatory (now called the Lamont-Doherty Earth Observatory, LDEO), under contracts to several agencies, conducted several field surveys of PCB levels in the sediments, suspended matter and water column of the Hudson River over the period 1976 to 1988 (Bopp, 1979; Bopp *et al.* 1982; Bopp, 1983; Bopp *et al.*, 1985; Bopp *et al.*, 1988; and Bopp and Simpson, 1989). The Observatory also conducted a study of PCB sediment to water partitioning under a contract with NYSDEC (Warren *et al.*, 1987). The field surveys included collection of dozens of cores covering the Hudson River from above Hudson Falls to the New York City Harbor. Many sections of the cores were analyzed for radionuclides to establish core chronologies as well as for PCB concentrations, with an emphasis on homologue- and congener-specific information. Three cores are included in the Reassessment database under the *LDEO* directory. In addition, the results of the PCB water-to-sediment partitioning study are included as well. These tables are distinctly different from the remainder of the Reassessment database tables.

Specifically, these tables exist in Lotus 1-2-3™ format and contain data and descriptive text. These tables, which are not relational databases, are listed on Table 2-3.

Other Sources of Sediment Data Not in the Reassessment Database

In August 1983, USEPA conducted a limited study to collect sediment samples from locations that had been sampled in 1976 to 1978 (NUS, 1984). Over sixty core and grab samples were collected within a nine-mile stretch of the river south of Rogers Island, including the Thompson Island Pool. Forty-two samples were collected from within or on the border of previously determined *hot spots*.

In addition to PCBs in river sediments, other chemicals, particularly heavy metals, were measured during the 1976-78 NYSDEC study (Tofflemire and Quinn, 1979), the 1984 Thompson Island Pool study (Brown *et al.*, 1988), and by other investigators. Lead, cadmium, zinc, chromium, mercury, and other metals were measured.

Relatively few sediment samples have been tested for other organic priority pollutants. Four sections of two cores collected in 1983 by Dr. Richard Bopp between River Mile 188.5 and 191.1 were submitted to NYSDOH and analyzed for dioxin and dibenzofurans. Six sediment samples collected in 1987 from three *hot spots* were analyzed for dioxins, dibenzofurans, volatile and semi-volatile organics, and pesticides (Brown *et al.*, 1988). With the exception of

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dibenzofurans, none of these organic parameters were detected in the 1987 samples.

2.1.2 Fish and Aquatic Biota

The database contains data for approximately 11,000 historical fish samples under the subdirectory *HISTORIC\FISH* for the period 1973 through 1993. These files contain data for both the Hudson River proper and tributaries. These Hudson River proper data can be distinguished from the other data because a river mile identifier has been assigned only to Hudson River samples; this field is blank for samples from tributaries or ocean water beyond the Verrazano-Narrows Bridge. Additional data for other aquatic biota (macroinvertebrate and multiplate data) account for several hundred additional samples. These data are found in the *HISTORIC\MACROINV* subdirectory. NYSDOH monitored multiplate samples and chironomid larvae from 1973 through 1985. A discussion of the specific fish/biota studies from which data have been extracted for the database is provided below. Table 2-3 lists the data sources.

NYSDEC Fish Sampling

Data exist on concentrations of PCBs in Hudson River fish collected by NYSDEC between 1970 and 1993. While over 30 species of fish are represented in the data, 75 percent of the samples are from a half-dozen species including striped bass, largemouth bass, brown bullhead, pumpkinseed, american shad, and american eel. Approximately two-thirds of the samples tested were standard fillet samples, with most of the remainder being whole fish. The type of sample is identified by the **Prep** field for sample preparation in the database. In the database, sampling information identifies the species, sex, age, sample weight and length, whether the samples represent composites or individuals, as well as date and location, *i.e.*, river mile of sample collection, and data source.

Samples Collected Prior to 1975

While polychlorinated biphenyls are known to have been discharged into the Upper Hudson River since the 1940s, no testing for PCBs in fish is known to have been undertaken before 1970. Summary statistics of results for fish samples collected and analyzed for PCBs in the period 1970 through 1974 are reported by Spagnoli and Skinner (1977); however, the complete data set for this period are unavailable. These samples include one smallmouth bass collected at Warrensburg and 146 fish representing 11 species collected below the Troy Dam. In August 1974, a team from USEPA Region II visited the Fort Edward, NY area and obtained water, sediment and fish samples from upstream and downstream of the GE discharge in Fort Edward. Samples collected prior to 1975 can be identified by the entry in the sample year field (**Yr**).

Samples Collected from 1975 to 1976

NYSDEC undertook more detailed monitoring of PCBs in fish from both the Upper and Lower Hudson during 1975 and 1976. A total of 440 Hudson River fish samples were analyzed in this period and results have been provided by NYSDEC. These data have been merged with the

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earlier data in the *HISTORIC\FISH* subdirectory.

The 1975 to 1976 fish collections were made by regional NYSDEC Fish and Wildlife personnel who were instructed on specific species and sizes of fish desired, location of stations and time tables for collection. Target species for the Hudson included smallmouth bass, largemouth bass, brown bullhead, goldfish, white sucker, striped bass and various other estuarine species. Other species were occasionally obtained as available. The sample species is identified via the species code in the **Species** field of the database. Attempts were made to sample small, medium (minimum legal) and large representatives of each species.

Samples Collected from 1977 through 1993

By 1979, NYSDEC monitoring methods had been refined and standardized. NYSDEC has provided data covering the period 1977 through 1993 (Sloan, 1994), which include fish and fish composite analyses. Samples were collected on a regular basis, with the intent of sampling selected species at predetermined locations within two-week intervals to minimize potential seasonal effects. Sample collection, preparation, and analytical methods are described in Armstrong and Sloan (1981), Sloan and Horn (1986), and Sloan *et al.* (1988). In 1979, a special project was started to monitor PCB accumulation based on a single year of exposure. For this project, yearling pumpkinseed were selected due to their abundance and non-migratory behavior.

Analyses were conducted by several different state laboratories, apparently using the methodology of Bush and Lo (1973), and reported against standards for Aroclor 1254 and either Aroclor 1242 or 1016. Aroclor 1221 was not analyzed. The nominal quantitation limit of the method was 0.01 ppm, although some of the laboratories reported results only as low as 0.1 ppm. NYSDEC determined total PCBs as the sum of Aroclors 1242, 1016, and 1254 for these data.

NYSDOH Macroinvertebrate Studies

As part of the Hudson River PCB Reclamation Demonstration Project, NYSDOH conducted biomonitoring studies from 1976 through 1985 using caddisfly larvae, multiplate samples, and chironomid larvae (Simpson *et al.*, 1986). These studies included long-term biomonitoring efforts over the entire period, as well as two short-term biological uptake studies in July and September of 1985. From 1976 through 1985, artificial substrate samplers (multiplates) were placed at 17 sites along the Hudson River from Hudson Falls to Nyack, New York (Novak *et al.*, 1988) (See Figure 2-6). These samples were collected over a period of five weeks occurring during the months of July, August and September and were analyzed for concentrations of Aroclors 1016 and 1254. The resulting PCB concentrations in the multiplate samples represented a composite of concentrations in sediment, algae, plankton, and various macroinvertebrates. Invertebrates collected in the multiplate samplers included the following taxonomic groups: *Chironomidae*, *Oligochataeta*, *Trichoptera*, *Ephemeroptera*, *Amphipoda*, and *Elimidae*. Chironomid larvae and pupae were the most abundant invertebrate component from Fort Edward to Saugerties, comprising up to 86 percent of the total macroinvertebrate population at Fort Miller and Waterford.

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From 1978 through 1985, caddisfly larvae were collected by hand-picking individuals from rocks at five designated sites: Hudson Falls, Fort Edward, Fort Miller, Stillwater, and Waterford. Caddisfly collections were made in June, July, August and September of each year.

Short-term biomonitoring investigations using the chironomid larvae, *Chironomus tentans*, were also performed by NYSDOH during July and September 1985 (Novak *et al.*, 1990). The monitoring method consisted of placing 25 laboratory-reared chironomid larvae in nylon mesh envelopes or packets that were exposed to the water column. Envelopes were placed in groups of ten in steel mesh baskets at the primary collection site and monitored at 0, 1, 2, 4, 8, 12, 24, 48, 72, and 96 hours. Chironomids were placed at four sites, including two at Thompson Island Pool, one at Bakers Falls and one at Fish Creek, and monitored at 96 hours. Packets of chironomids exposed to the sediment at a collection site located on the eastern shore of the Thompson Island Pool were also collected at 96 hours.

The macroinvertebrate data provided in the database were obtained directly from NYSDOH reports. The locations of the samples are defined by a simple code referring to the 17 sites. These sites are defined in the **DOHSITE** data table of the *HISTORIC\MACROINV* subdirectory. The species monitored as part of these studies were identified in the original reports with a simple number code from 1 to 9. No documentation was found to define these codes. These identifier codes are given in the **Species** field of the **SAMPLE** data table. The results of the study which dealt explicitly with caddisfly larvae have an assigned species code value of 20 in the **Species** field.

2.2 USGS Surface Water Flow and Water Quality Data

The U.S. Geological Survey (USGS) has maintained numerous surface water monitoring stations along the Upper Hudson. These stations have been used to monitor flow, suspended sediment, PCBs, and other water quality parameters. The USGS data, obtained from WATSTORE and the Albany USGS office, provide the longest and most comprehensive record of surface water information available for the Upper Hudson. Flow records, suspended sediment data, and total PCB water column monitoring are discussed below. Table 2-3 lists the monitoring programs and the associated subdirectories where these data are contained. In general, the USGS data contained in the Reassessment database were obtained from WATSTORE, the most recent retrieval being August 1995 (WATSTORE, 1995). As of this date, flow data were available up to October 1, 1993 and water quality data up to 1994. The water quality data retrieved from WATSTORE for this database were limited to those parameters important to the characterization of PCB transport. Specifically, this included total suspended solids, total organic carbon and PCBs. No other water quality data were included in the Reassessment database.

2.2.1 USGS Flow Records

The USGS has collected river discharge (flow) and water quality data at various points along the Upper Hudson River as indicated on Figure 2-3. The lengths of record for the daily flow series at individual locations on the Hudson vary widely, but records are extant from 1907 through the present. Water quality records pertaining to PCBs generally begin in the mid-1970s. TAMS/Gradient obtained the USGS records of the monitoring stations located on the Hudson and its major tributaries between Hadley, New York, which is well upstream of Fort Edward, and Green Island, which is below the confluence with the Mohawk River near Albany, for use in this investigation.

The majority of the USGS flow monitoring stations on the Upper Hudson have periods of record beginning in the 1970s, although continuous monitoring is available at Hadley since 1921. Earlier records are available for the Hudson River at Thurman, NY (Station No. 0131800) for 1908 through 1911 and 1919 through 1920, and for the Hudson River at Spier Falls (No. 01326500) for 1912 through 1923.

While the majority of the USGS flow monitoring data was obtained to examine and estimate PCB loading, it was also needed to examine flood frequency in the Upper Hudson. In order to obtain an extended period of record for analysis of flood recurrence in the Upper Hudson, it was necessary to use the data from a station well upstream of Fort Edward, at the confluence of the Hudson and Sacandaga Rivers, near Hadley, as shown on Figure 2-3. The USGS has maintained a monitoring station in this location since July 1921. The Sacandaga River, a major tributary of the Hudson, enters slightly below Hadley. It has been monitored at Stewarts Bridge near the confluence since September 1907. Table 2-5 provides a brief description of the USGS surface water flow monitoring stations that are included in the database, including the period of record.

It is important to note that the quality of the USGS flow monitoring data varies from location to location as well as over time. In particular, ice coverage of the river greatly limits the accuracy of many flow monitoring stations. The users of these data should refer to the USGS Water Resources Bulletin for a description of each station's flow monitoring data quality. Of particular concern to the Phase 2 monitoring program were the USGS flow records for Stillwater and Waterford for 1993. Due to construction at these sites, the regular staff gauge readings were unavailable during the Phase 2 water sampling programs. As a result, the USGS was forced to estimate the readings at these locations. This delayed the release of this information for many months. Because of this delay and the anticipated uncertainty of these data, flows at Stillwater and Waterford were estimated based on NYSDOT Champlain Canal gauges. The calculated results are discussed briefly in Section 2.5.6 and will be presented in detail in a subsequent Phase 2 Report.

2.2.2 USGS Suspended Sediment Data

Several water quality stations were established on the Upper Hudson in 1969 but measurements of suspended sediment in the water column did not commence until 1975. Monitoring has not been continuous nor on a set schedule, and there has been a tendency to focus on spring flood periods, with little data available for the winter months. A list of water quality monitoring stations, including the periods of record in the database, is provided in Table 2-6.

2.2.3 Monitoring of PCBs in the Water Column

Regular monitoring of PCBs in the water column in the Upper Hudson was initiated by the USGS in late 1975 at Waterford, and expanded to other upstream stations in 1977. Most other sampling programs have been of short duration. The USGS data are, thus, the primary source of time-series information indicative of trends in water column PCB concentrations for the Hudson River.

USGS observations of PCB concentrations have been made at the same water quality stations as suspended sediment measurements (See Table 2-6). Data sets of significant size are available for Fort Edward, Schuylerville, Stillwater, and Waterford, with a limited record at Fort Miller. In addition there are data for project background samples collected upstream of Fort Edward at Glens Falls.

Methods of data collection and analysis are summarized in Turk and Troutman (1981), and Schroeder and Barnes (1983a). Analyses for total recoverable PCB concentrations were performed on unfiltered samples, and results therefore include the dissolved as well as the particulate fraction. Dissolved PCB concentrations were determined on samples filtered through 0.45 micron silver oxide filters. However, dissolved concentrations were determined on less than five percent of the samples.

The concentrations reported were not corrected for incomplete extraction. However, Schroeder and Barnes contend that extraction efficiency is greater than 80 percent for Hudson River water because the river is relatively low in suspended sediment and dissolved organic carbon concentrations. Extraction efficiency may be an issue for periods of high suspended sediment load.

Although the USGS laboratory reports a theoretical quantitation limit of 0.01 g/L through 1983, the practical quantitation limit was considered to be 0.1 g/L because of the small size of the water samples (Bopp *et al.*, 1985). Data for this period recorded on the USGS central database, WATSTORE, contain both values entered as 0 and values coded as < 0.10 g/L. Apparently these are both intended to represent non-detects at the 0.1 g/L quantitation level, and the inconsistency is unintentional (Rogers, 1991, personal communication). With water year 1984 the practical quantitation limit was lowered to 0.01 g/L. Nevertheless, the 1984 and 1985 data are reported on WATSTORE *as if* they adhere to the previous quantitation limit of 0.1 g/L. In 1986, the quantitation limit began to be reported as 0.01 g/L in WATSTORE.

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2.2.4 Total Organic Carbon (TOC) Data

Some TOC data collected by the USGS have been merged into the database. These data span the period from July 1974 through September 1979 and represent the total organic carbon levels from unfiltered or whole water samples.

2.2.5 Sources of Water Column Data Not Contained in Database

Two water column studies are described below: Waterford Treatment Plant Data and Lamont-Doherty Geological Observatory Study. These data were not provided in an electronic format and were excluded from the database since they were not needed for the quantitative evaluations performed during Phase 2.

Waterford Treatment Plant Data

The City of Waterford, NY operates a water works serving a population of approximately 12,000 persons in the towns of Waterford and Halfmoon and the Village of Waterford. This is the northernmost water treatment facility drawing water from the Hudson downstream of the Fort Edward area. In 1975, when the USGS began collecting PCB data in the river at Waterford, they also began collecting data for raw water input and treated water output at the Waterford treatment plant, in cooperation with the Board of Water Commissioners of the Town of Waterford and the NYSDEC (Schroeder and Barnes, 1983b). The water for the treatment plant is drawn from a location 0.5 km upstream of the U.S. Highway 4 bridge, where Hudson River water samples are taken at Waterford. For this location, data collected in cooperation with the USGS continue through the end of water year 1983. In addition, data collected approximately bimonthly for November 1983 through February 1985 and March 1987 through October 1989 are available from the Waterford Water Works (Metcalf & Eddy, 1990).

Lamont-Doherty Geological Observatory Study of 1983

A detailed study of PCB transport in the Upper Hudson was conducted by personnel of Lamont-Doherty Geological Observatory in 1983 (Bopp *et al.*, 1985). This involved an investigation of Spring-Summer 1983 PCB transport in the Upper Hudson, which was a period of relatively high flows. The Lamont-Doherty study included the collection of data not available from USGS sampling. This study included 20 large-volume filter samples of suspended matter, and 15 nine-liter to 20-liter water samples, collected from Troy to Glens Falls. Unlike USGS monitoring, detailed analysis of both the dissolved and suspended matter PCB fractions of these samples was undertaken.

2.3 GE Data

General Electric has conducted numerous environmental monitoring programs in the Hudson River (See Table 2-3 and Figures 2-7 through 2-12). Analytical results for work

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completed after 1990 from these programs were assembled and an updated version was transmitted to TAMS/Gradient in August 1995. The discussion below will address only the post-1990 results since the prior work was discussed in Section 2.1.1 of this chapter. The database in the *GE* directory includes analytical results for water, sediment, pore water and biota samples from the following:

- 1991 Sediment Program
- Temporal Water Column Monitoring Program
- Post-Construction Remnant Deposit Monitoring Program
- Baker's Falls Investigation
- Observation of USEPA Sampling Effort
- Channel Characterization
- Biota Survey
- Highflow Sampling Program
- Archived NYSDEC Fish Samples
- Analysis of Aroclor Standards

GE has provided data for over 1,500 water column samples spanning a period from April 1991 to June 1994. The results include measurements of total PCBs, PCB homologue distributions and capillary column peak concentrations, as well as some conventional parameters such as total dissolved solids, total alkalinity, total suspended solids, and water temperature. Data for over 400 sediment samples are reported, although most represent composited samples rather than single sediment cores. In addition to total PCBs, homologue distributions and capillary column peak concentrations, measurements of bulk density, percent moisture, total organic carbon, and total percent solids are reported for core composites. Sediment samples exist for the 1991 Sediment Program and for the 1992 Channel Characterization Program. Results for 86 pore water samples collected during the 1991 Sediment Program are also contained in the database. Finally, the database includes 75 archived NYSDEC fish samples and 18 biota samples (largely fish samples) from the GE 1992 Food Chain Program (O'Brien and Gere Engineers, Inc., 1993).

It should be noted that the GE capillary column peak quantitations are similar to but not identical to the congener-specific analysis used by USEPA/TAMS in the Phase 2 investigations. The GE data, however, are quantitated based on Aroclor standards and not the individual congener standards used in Phase 2. This leads to some differences in PCB quantitation between the two techniques. This issue, as well as others, will be discussed in subsequent Phase 2 reports. A look-up table (designated by its acronym LUT) **PCB_LUT**, is provided in the database which represents a key relating the capillary peak results to their likely congener identities.

2.4 Staffing Gauge Data

Staff gauge readings were obtained from the NYS Department of Transportation relating to staff gauges along the portion of the Champlain Canal lying within the Upper Hudson (NYS Thruway Authority, 1993). The canal is now controlled by the NYS Thruway Authority which is

the current source for these data. These data represent water levels in the Upper Hudson relative to the NYS barge canal datum. These values can be converted to the Nation Geodetic Vertical Datum by adding 1.177 feet to the readings. The staff gauge data can be found in **GAUGES** in the *NYSDOT* directory (See Table 2-3). The data are arranged by date and represent the staff gauge readings from 1977 to 1993. Readings from different staff gauges are included, representing water levels from Fort Edward (Lock 7) to Waterford (Lock 1). Of particular note, staff gauge 118 represents the water level above Lock 6, which corresponds to the southern end of the Thompson Island Pool.

The staff gauge data contained in the database represent the average of two daily readings collected at each gauge as reported by the NYSDOT. The gauges are not recorded consistently during flood and canal off-season periods so the data are generally limited to April through November of each year. These data were obtained to assist in the calculation of Hudson River flow in 1993 as well as for use in sediment transport modeling. The staff gauge data table **GAUGES** contains all available data for the gauges listed for the period 1983 to 1993. Earlier years were added for the purpose of calibrating flows at Schuylerville, a USGS station with a limited dataset, *i.e.*, restricted to the period 1977 to 1979.

2.5 RI/FS Phase 2 Sampling Effort

The results of the analytical program for Phase 2 of the Hudson River PCBs Reassessment RI/FS can be separated into the basic studies conducted by USEPA/TAMS (with one exception, as noted) as described below and summarized in Tables 2-2 and 2-3.

Water Column Study - Investigation of water column PCB levels, transport and sources via sequential sampling along transects, collection of flow-averaged composite samples and collection of daily suspended matter samples.

Water Column PCB Equilibration Study - Examination of dissolved phase to suspended matter partitioning of PCB congeners.

Confirmatory Sampling Study - Examination of river sediment for the purposes of interpreting geophysical data.

High-Resolution Sediment Coring Study - Investigation of long-term trends in PCB transport, release and degradation via an examination of the sediment record.

Ecological Program - Investigation of PCB levels and other parameters in Hudson River fish, benthic invertebrates and sediments from 20 sites distributed throughout the Hudson.

Fish Sampling Study (NOAA) - Analysis of supplementary fish samples collected as part of the Ecological Program.

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High-Flow Suspended Solids Monitoring Study - Collection of suspended matter samples during the annual spring high flow event in Spring 1994.

Low-Resolution Sediment Coring Program - Investigation of PCB levels in selected *hot spot* areas of the Upper Hudson.

TAMS/Gradient procured the services of a number of laboratories to perform analyses required for the Phase 2 studies. Of the analyses required, only metals are included in the USEPA Contract Laboratory Program (CLP) Routine Analytical Services (RAS) procurement process. For non-routine analyses having standard methodologies, laboratory services were solicited through the USEPA CLP Special Analytical Services (SAS) procurement process. Analyses with non-standard methods or requiring special attention of project investigators were performed by laboratories procured directly by TAMS/Gradient, including those associated with research institutions employed on the project. In some cases, similar analyses were performed by directly-procured and SAS laboratories for comparison purposes, or to serve different sampling events, depending on project needs. The laboratories employed for particular analyses are shown in Table 2-7.

Data from each of the studies have been incorporated into the database. Sediment results from the confirmatory sampling study and the low resolution sediment coring program reside in the *SEDIMENT* subdirectory under *PHASE2*. Sampling results from the water column study, the water column PCB equilibration study and the high flow suspended solids monitoring study are stored in the subdirectory *WATER*. Results of the high-resolution sediment cores are contained in the *HRCORES* subdirectory. Results for the ecological program are in the *ECO* subdirectory under *PHASE2*, and the NOAA results are in the *NOAA* subdirectory.

In the database design, the sample identifier, which uniquely defines each sample, is divided into two database fields, *i.e.*, **TAMS ID** and **TAMS Type**. This identifier contains the basic sample description information and can be used to simplify most database queries. A third field, **Species**, is required to uniquely identify the ecological biota samples as well as the fish samples analyzed by NOAA. The sample naming convention for each process is described below with examples. It is always necessary to use at least two, and sometimes three, fields to extract the desired physical sample measurement to ensure the correct data are related from the various databases. Examples to illustrate this point are given in Chapter 3.

A result that is not detected is always reported with at least a "U" in the data qualifier field for all data. The sample quantitation limit is then reported as the **Value** for a non-detected result. Thus, a user must not simply take the mean or maximum, or perform any other statistics on the concentration in the **Value** field without first testing for the qualifier and assigning a scheme for non-detected concentration values.

Handling of Sample Duplicates

Reported sample duplicates fall into three groups: laboratory splits, field split samples and co-located field samples. In all programs except the ecological investigation, sample duplicates were handled as discussed below. Ecological sample duplicate handling is discussed in Section 2.5.5. For the field co-locate samples, unless one of the results was rejected during data validation, the results are averaged and the means are reported in the database tables in order to obtain the best estimate of the measured properties at the location. Results for field split samples (*i.e.*, two samples taken from a single homogenized sample volume) were not averaged. Instead, the first analysis is kept in the main data table and is labeled "FS1" in the **Split** field, while the second is placed in an analysis duplicate table under the appropriate *QA_QC* subdirectory and is labeled "FS2" in the **Split** field. Laboratory splits yield a measure of analytical precision while field splits and samples which are co-located yield additional information on the local variability of a measured property. Only the first analysis result of a laboratory split series is retained in the main database table and is labeled "LS1" in the **Split** field. The remaining results of a series are stored under the appropriate analysis duplicate table in the *QA_QC* subdirectory and are labeled "LS2", "LS3", etc., depending on how many split analyses were performed. Both field splits and co-located samples are labeled with a "D" in the **TAMS Type** data field. The **Split** field is used to indicate the type of duplicate analysis. For pairs of co-located samples, both original samples have been moved to a separate table and only the mean of the results of the co-located samples is contained in the main database tables. These mean results are labeled with "Avg-FC" in the **Split** field to denote the composite record.

The analytical values from co-located samples were combined for input to the database as follows:

	<u>Combined PCB Results</u>	<u>Combined Non-PCB Results</u>
<i>Duplicate detected results</i>	<i>Mean of results; qualifier left blank.</i>	<i>Mean of results; composite qualifier carried over.</i>
<i>Duplicate non-detected results</i>	<i>Mean of reported detection limits (quantitation limits); qualifier left as "U."</i>	<i>Mean of results; qualifier left as "U."</i>
<i>Detected and non-detected result pairs</i>	<i>Mean of detected value and 1/2 quantitation limit for non-detected results (<i>i.e.</i> analyte is considered detected); qualifier left blank.</i>	<i>Mean of detected value and 1/2 quantitation limit for non-detected results; detected-value qualifier carried over.</i>
<i>Detected and rejected result pairs</i>	<i>Detected value and its qualifier are reported.</i>	<i>Detected value and its qualifier are reported.</i>
<i>Non-detected and rejected result pairs</i>	<i>Reported detection limit is retained along with "U" qualifier.</i>	<i>Reported detection limit is retained along with "U" qualifier.</i>

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Sample Location Data

Sample locations for the Phase 2 investigation fall into two types, surveyed locations and estimated locations. Sampling sites for the confirmatory sampling and low-resolution coring programs were surveyed in place based on on-shore control points. All other coordinate information, including river mile, represent estimated locations derived from USGS quadrangle maps and other sources. Surveyed coordinates are contained in the **Northing** and **Easting** fields while estimated coordinates are contained in the **Est Northing** and **Est Easting** fields. All coordinates are referenced to the NYS plane coordinate system.

PCB Congener Results

PCB congener results are reported for the high-resolution coring, water column transect sampling, flow-averaged water column sampling, ecological sampling and low-resolution coring programs. The PCB congener analysis consisted of 90 congeners whose identity and quantity were established by individual congener standards. These are labeled as "target" congeners. The look-up table **CONG_LUT** under *PHASE2* provides a listing of these congeners. An additional 37 to 50 congener results are reported based on laboratory-determined retention times and congener response factors. For most of these congeners, no congener standards were run at the time of analysis. These congeners are labeled "non-target" in the Phase 2 database.

With regard to Phase 2 PCB congener analysis, the following should be noted. Due to changes in the chromatographic columns used by the contract laboratory for congener analysis during the summer of 1993, congeners BZ#4 and BZ#10 could not be represented in a limited number of samples. This affected three flow-averaged water column sampling events, one water column transect and the sediment analyses performed for the ecological field investigation. In these instances, the analytical result was reported as a coeluting peak "BZ#4 and BZ#10." However, due to the need to resolve and quantitate BZ#4 more accurately, this coeluting peak was split into BZ#4 and BZ#10 based on their known individual analytical response factors and the ratio of their occurrence in the environment. This separation will be discussed in more detail in the data usability section of the Phase 2 Data Evaluation and Interpretation Report.

Sample Grouping

In the creation of the database, samples within various media were grouped by appropriate criteria, generally by geographic area, in order to assess general property characteristics and to establish a treatment procedure for non-detect values. In general, the recommendation put forth under USEPA (USEPA, 1989) for dealing with non-detects was applied to the Reassessment database. For nearly all non-PCB analyses, non-detect values were infrequent and had little effect on the use of the data. For PCB congener data, non-detect results occurred frequently enough that a systematic scheme was required to handle them consistently.

In all PCB congener tables, two fields labeled **Value1** and **Value2** are reported. **Value1** field represents the validated data with non-detect levels as reported by the laboratory and confirmed by validation. The **Value2** field contains the validated congener detections along with a

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modified value for the non-detect results. The non-detect results for a given congener were assigned a value of zero when non-detects for that specific congener occurred in more than 15 percent of the samples within a sample group. When nondetects represented less than 15 percent of results for a specific congener in a sample group, the congener was assigned a value of one-half of the detection limit.

Homologue and Aroclor Sums

Using these results, congener sums were created to represent homologue, total PCB and Aroclor concentrations. For these sums, target and non-target congener results were combined as appropriate. However, all sums were created based on the original 90 target congeners plus the 37 non-target congeners common to all analyses. The additional 13 non-target congeners were not included in these sums to maintain consistency across all analyses.

To create homologue sums, each congener record in the database is associated with a homologue group; *e.g.*, BZ#12 is 3,4-dichlorobiphenyl in the dichloro-homologue group. In the case of multiple congeners eluting together, the homologue group assigned is either the predominant or least chlorinated one present, *e.g.*, the coeluting congeners BZ#37 and BZ#59 are in the trichloro-homologue group because BZ#37 is a trichloro-homologue and is the least chlorinated. BZ#59 is a tetrachloro-homologue. The total PCB value represents the sum of the 127 standard PCB congeners. The Aroclor sums represent the sum of only those congeners found in Aroclor standards run as part of the Phase 2 analytical program. Specifically, only those congeners present at 0.1% or more in a given Aroclor mixture are included in the Aroclor sum. For the Aroclor sums where more than one Aroclor is listed (*e.g.* Ar1016-Ar1242), the sum is constructed by adding together all congeners present in either Aroclor standard. This sum avoids any "double counting" since each congener is added to the sum only once regardless of the number of Aroclor mixtures in which it occurs. As noted above, the homologue and Aroclor sums provided in the Phase 2 data tables are based on the 127 standard congeners and are listed below:

Parameter Name	Description
Mono	Sum of monochloro-homologue congeners
Di	Sum of dichloro-homologue congeners
Tri	Sum of trichloro-homologue congeners
Tetra	Sum of tetrachloro-homologue congeners
Penta	Sum of pentachloro-homologue congeners
Hexa	Sum of hexachloro-homologue congeners
Hepta	Sum of heptachloro-homologue congeners
Octa	Sum of octachloro-homologue congeners

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Parameter Name	Description
Nona	Sum of nonachloro-homologue congeners
Deca	Decachloro-homologue congener
Total PCBs	Sum of all congeners
Aroclor 1016	Congener-based Aroclor 1016
Aroclor 1221	Congener-based Aroclor 1221
Aroclor 1232	Congener-based Aroclor 1232
Aroclor 1242	Congener-based Aroclor 1242
Aroclor 1248	Congener-based Aroclor 1248
Aroclor 1254	Congener-based Aroclor 1254
Aroclor 1260	Congener-based Aroclor 1260
Ar1016-Ar1242	Congener-based composite of Aroclor 1016 and 1242
Ar1221-Ar1232	Congener-based composite of Aroclor 1221 and 1232
Ar1016-Ar1248-Ar1254	Congener-based composite of Aroclor 1016, 1248 and 1254

Similar to the results for the individual congeners, two values are given for the homologue, total PCB and Aroclor sums. These sums are included in the **Value1** and **Value2** fields. The value given for these parameters in the **Value1** field represents the sum of the detected congener concentrations. In creating this sum, non-detect congeners are set equal to zero. Thus the homologue, total PCB and Aroclor sums given in **Value1** cannot be obtained by simply summing the associated congener values listed in the **Value1** field since **Value1** contains both the measured quantities for detected congeners and the quantitation limits for non-detected congeners. The homologue, total PCB and Aroclor sums given in **Value2** represent the sum of detected and non-detected congeners. In this instance, the non-detected congeners have been assigned values based on the rules described previously in the section entitled "Sample Grouping". The summation scheme described above was applied to all PCB congener data tables in the same manner. Thus, all PCB congener tables contain 2 concentration fields, **Value1** and **Value2**, and 21 congener summation results (10 homologues, 10 Aroclors and total PCBs) for each sample analyzed.

2.5.1 Water Column Transect, Flow-Averaged Sampling and Suspended Solids Monitoring Programs

The Phase 2 water column program conducted by TAMS during 1993 was intended to address several issues concerning riverine PCB contamination, including:

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- the sources of PCBs to the Upper Hudson, particularly those in the area of the Thompson Island Pool;
- the nature of the PCB mixture as it enters the river, *e.g.*, dissolved phase- or particle phase-dominant;
- seasonal variations in the flux of PCBs in the Upper Hudson;
- the factors influencing PCB transport and water column concentrations, such as seasonal or flow variations;
- seasonal variations in water column conditions;
- suspended matter *versus* dissolved phase distributions of PCB congeners and how closely they approach an equilibrium distribution;
- the use of equilibrium-based assumptions to predict mean PCB transport; and
- the importance of PCB suspended matter to dissolved phase disequilibrium in the Upper Hudson.

This section provides general comments on the water column samples themselves, including naming conventions, handling of sample duplicates and locations of sample stations. A description of each of the sampling programs follows. Figures 2-13A and 2-13B show the water column sampling locations for the Upper Hudson and Lower Hudson, respectively. Figure 2-14 shows the suspended solids monitoring locations.

General Comments

Water column data on PCB levels were collected during two separate sampling programs: the transect sampling program and the flow-averaged sampling program. Samples from the transect program are identified by an initial "T" in the **TAMS ID**, followed by an "S" for suspended matter or a "W" for the filtered water, *i.e.*, dissolved phase sample. Flow-averaged samples are identified by an initial "F," also followed by an "S" or "W" denoting the sample matrix. The middle three digits refer to the transect or flow-averaged sampling event and the last four digits refer to the sampling station. For example, sample name TS-001-0008 represents the suspended matter transect sample from transect 1, station 0008; sample name FW-002-0005 refers to the filtered water sample from flow-averaged event 2 at station 0005.

Daily samples collected during flow-averaged sampling events are denoted by incrementing the middle three digits in the sample identifier, *e.g.*, 101 for day 1 of flow-averaged sampling event 1, 102 for day 2 of flow-averaged sampling event 1, etc. Composited samples of

the first eight days, either mechanical or mathematical, are designated by a "9," *e.g.*, 109 for composited flow-averaged event 1, or 209 for composited flow-averaged event 2. Finally, a "D" or "M" in the **TAMS Type** field for either a transect sample or a flow-averaged sample refers to a duplicate sample or matrix spike sample, respectively. A duplicate sample result is averaged with the primary sample result of the duplicate pair while the matrix spike sample represents a sample taken at double volume to provide enough mass for an additional laboratory quality control analysis.

The results for sampling days 1 through 8 can be used as independent, instantaneous measurements. The measurements for temperature, conductivity, and dissolved oxygen for these days are included in the database table called **NONPCBW**. Water column transect and flow-averaged sampling programs use the same station numbering scheme. The sampling stations and their descriptions and a listing of the water sampling events and their dates are given in Tables 2-8 and 2-9.

In addition to the PCB sampling programs, two studies were conducted to monitor suspended solids in the Upper Hudson during 1993 and 1994. During 1993, suspended solids and weight-loss-on-ignition were determined for samples collected at Waterford (Station 8) five days per week for April through October. Mechanicville (Station 19) and Lock 2 (Station 26) were also sampled during portions of this period. These samples are labeled with an initial "S1" in the **TAMS ID** for suspended solids monitoring study number 1. The middle three digits refer to the julian calendar day and the last four digits refer to the station number. For example, S1-097-0008 represent the sample collected at Waterford on julian day 97 of 1993, *i.e.* April 7, 1993.

A second suspended solids study was conducted during 1994. This study obtained data on total suspended solids, weight-loss-on-ignition and total suspended organic carbon during a one-month period centered on the annual spring high flow event. These samples were intended to provide a detailed data set concerning suspended matter transport. In all, 18 stations were sampled on some or all of 21 different days during this 32-day sampling event. Table 2-8 lists all of the stations occupied as part of the suspended solids monitoring programs. Samples collected during this event are indicated by an initial "S2" in the **TAMS ID** field. The remaining identifier digits are assembled in the same fashion as the "S1" event. For example, "S2-090-0007" represents the sample collected at Stillwater (Station 7) on julian day 90 of 1994, *i.e.*, March 31, 1994.

In addition to the coded sample information contained in the **TAMS ID** field, other sample information is contained in the **TAMS Type** field. Co-located water samples are indicated by a "D" in this field. True water sample splits were not generated due to the difficulties in homogenizing the large volumes of water collected in the water column studies and the concern over loss of PCBs by the homogenization process. Instead, field co-locate samples were collected on an individual basis for each parameter at a given sampling site. That is, if a field co-locate pair was to be collected at a given sampling site, two sample bottle sets were collected for TSS analysis, two sample bottle sets were collected for PCB analysis, two sample bottle sets were collected for DOC analysis, etc. In these pairs, one bottle set would be labelled with a "D" in the

TAMS Type field. Thus, the analytical results for PCBs, TSS, etc., for each sample in a co-locate pair (e.g., all the results with a given **TAMS ID** and with **TAMS Type** equal to "D") do not represent a matched set. Only the average result for a specific analyte for a co-locate sample pair should be used in a global fashion to describe conditions at the time of collection. The individual analyte co-locate pairs provide information on the combined analytical and sampling precision for the given analyte.

All field co-locate samples for the transect and flow-averaged sampling events have been reported in the main analytical data tables (e.g. **PCBP**, **PCBW**, **NONPCBW**) as the mean value of the co-located sample results in the database, e.g., TS-004-0005 and TS-004-0005-D. The individual original co-locate sample pair results have been removed from the main database and placed in supplementary tables in the *WATER\QA_QC* subdirectory, i.e., **NONPCBWD**, **PCBWD**, **PCBPD**. The reported average result is indicated by the phrase "Avg-FC" in the **Split** field of the analytical data table. In this manner, each individual analyte (e.g. BZ#4, TSS) is marked to indicate that the reported value is the average of two field co-locate samples.

Samples collected as matrix spike/matrix spike duplicate samples for laboratory quality assurance are labeled with an "M" in **TAMS Type**. The results reported in the database are of the same quality as unmarked samples and can be used in the same fashion.

Sampling Program Descriptions

Each of the Phase 2 water sampling programs is described briefly below. Discussions on data results and interpretation will be provided in subsequent Phase 2 reports.

Transect Samples

The water column transect samples represent "snapshots" of conditions in the river and provide useful information on the congener pattern distribution and relationships between dissolved and suspended phases. These events consist of samples from 12 to 16 Hudson River proper and tributary stations. Three of the eight transects extend downstream of Federal Dam at Troy to three locations in the Lower Hudson River. Also, PCB flux, or loading, rates can be determined with flow and total suspended solids data.

Flow-Averaged Samples

Flow-averaged samples provide information regarding PCB flux on a whole-water basis by combining the results from the suspended matter and filtered water sample pairs. Flow-averaged samples were collected from only four main stem Hudson River stations.

The flow-averaged samples represent a flow-weighted mean water concentration for a 15-day period. Samples were collected every other day and composited into a single sample. The daily volume collected was determined by the flow at the USGS gauging station at Fort Edward, just above the Thompson Island Pool. By using the compositing technique, the variability inherent

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in individual daily samples was minimized and a truer measure of the mean PCB flux on a whole-water basis, *i.e.*, suspended plus dissolved phase, was obtained.

Suspended Solids Monitoring

These samples were collected to monitor and characterize total suspended solids transport in the Upper Hudson. Due to the affinity of PCBs for suspended sediment, accurate estimates of PCB transport are contingent upon accurate suspended solid loads. The high flow suspended solids monitoring event was intended to characterize suspended solids transport during the annual maximum flow condition. These studies are important to the accurate modeling of PCB transport in the Upper Hudson.

Equilibration Study Samples

Equilibration study samples were held for long periods of time prior to filtration to examine the particulate/water PCB distribution. These samples are designated with the letter "E" in the fourth position in the **TAMS ID**. These samples must not be used for any analysis other than the determination of partition coefficients. These samples were collected during two separate sampling events (transects 2 and 6) and therefore represent different water column conditions. Differences between the first equilibration study in February 1993 and the second equilibration study in August 1993 may be attributed to PCB loads, temperature, dissolved organic carbon, or other seasonal variations. These PCB samples reside in the **PCBWE** and **PCBPE** tables for water and particulate (suspended matter) samples respectively, under the *PHASE2\WATER\EQUILIB* subdirectory.

Miscellaneous Samples

Some sampling events deviated from normal length and frequency of sampling collection protocols. These samples can be combined with other water samples after applying the necessary corrections to account for the way in which these samples were collected. Specifically:

- For the first flow-averaged sampling event, two composites were collected at Waterford instead of one. The first, **TAMS Type** = "A1," represents four every-other-day samples collected over the period from April 23 to 30, 1993. The second represents four every-other-day samples collected over the period May 1 to 8, 1993. The results can be combined into a single flow-averaged value on the basis of the sampling day flows for each period. These samples are labeled FS-109-0008-A1 and FW-107-0008-A1 for the first week and FS-109-0008-A2 and FW-109-0008-A2 for the second week. During the first week of the first flow-averaged event, the lock above the Waterford station was opened at irregular and unpredictable intervals. This caused fluctuations in the discharge at Waterford and visibly variable suspended matter loads, which were not detected by the USGS station. During the second eight-day period, the flow appeared to reach a stable level. Approximately 16 liters of water were collected for each composite sample.

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- Prior to the beginning of the flow-averaged sampling program, four composite samples were collected at Waterford, representing time-averaged conditions. Each sample consisted of a composite of 20 one-liter samples collected daily, Monday through Friday, for a one-month period at Waterford. The composite samples were filtered to obtain dissolved phase and suspended matter fractions, as were other water samples, but the composite samples were outside of standard holding times. These suspended matter and dissolved phase PCB results were recombined to generate a single whole water result for the sample. These samples are labeled as FC-709-0008-C1 to FC-709-0008-C3, representing three one-month composites. Note that no corresponding total suspended solids (TSS) data are available for these samples. It is important to note that these samples represent the only temporally-composited samples in the Phase 2 data set and care must be taken to use them correctly. Because they are distinctly different from other Phase 2 results, these samples are placed in their own table, **PCBFA7**, and have a unique matrix name "wat/fil", indicating that they represent the combined water and filter result.
- Roughly two weeks after the main transect sampling event in April 1993, three additional samples were collected at three sampling stations: Fort Edward, Thompson Island Dam, and Waterford. These samples were not collected in a timed fashion, as were done with the other transect sampling events. These samples are labeled TS-008-0004, TS-008-0005, TS-008-0008, and TW-008-0004, TW-008-0005, TW-008-0008 for the suspended matter and dissolved phase fractions, respectively. The TSS data for these samples was collected as part of the on-going flow-averaged sampling so there are no TS-008 specific TSS samples. The correct TSS values can be obtained by matching the dates of these samples with those of flow-averaged event number 1.
- An additional set of one-liter water samples collected in the first water column transect are labeled with "TT" in the first two letters of the **TAMS ID**. These samples were not filtered and hence represent a whole water analysis, *i.e.*, a combination of suspended matter and dissolved phase fractions. As they are not comparable to the other filtered water samples, they have been moved to a separate table called **PCBTT**. Due to the inherent uncertainty in the PCB analysis resulting from their smaller size, these samples were not used in the Phase 2 data evaluation.

Finally, it is important to note that:

- The samples collected at Saratoga Springs (station 0009) are equivalent to field blanks and should not be used in any data analysis because it was taken as a background sample.

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Conventional Parameters

Results of the weight-loss-on-ignition (WLOI) analysis, a measure of organic matter content, are reported by RPI for nearly all water column study samples for two temperatures, 375 °C and 450 °C. The historical database for the Hudson River reports WLOI at 375 °C. For comparability to existing data, the value at 375 °C should be used. These data are available for all transects except the first, and all flow-averaged events. Total suspended sediment (TSS) and dissolved organic carbon (DOC) data, along with WLOI, are provided in the database table **NONPCBW** with duplicate pairs stored in *QA-QC NONPCBWD*. The TSS, chlorophyll-*a*, and DOC data provided by the USEPA SAS laboratory did not meet data quality objectives and have not been included in the database. Chlorophyll-*a* data reported by an alternate laboratory for water column transect samples met data quality objectives and are included in the database.

PCB Congeners

Water samples collected under the Phase 2 program have been filtered into two fractions for PCB analysis, a suspended matter fraction as well as a dissolved phase fraction representing both truly dissolved and dissolved organic carbon-bound PCBs. PCB congener data reside in two main database tables: **PCBP** for the suspended matter (particulate) fraction and **PCBW** for the dissolved phase (filtered water) fraction. In order to construct whole water column inventories, the results reported for both fractions must be summed. The suspended matter results are reported on a mass-per-unit-mass basis, g/kg, and must be multiplied by the corresponding TSS value for the sample in mg/L (x 1 kg/1000 mg) in order to calculate the suspended matter PCB concentration on a volume basis in ng/L. It should be noted that the congener data contained in the **PCBP** database does not represent the actual reported values. The original values for filtered samples were reported in ng/filter. These values were converted to g/kg by dividing by the sample volume (given in **VOLUMES**) and the suspended matter concentration (given in **NONPCBW**). The formula is as follows:

$$\text{Suspended Matter Conc} \left(\frac{\text{mg}}{\text{Kg}} \right) = \frac{\text{Reported Conc} \left(\frac{\text{ng}}{\text{filter}} \right) \times \frac{1 \text{ filter}}{\text{Sample Volume(L)}} \times \frac{1}{\text{Total Suspended Solids} \left(\frac{\text{mg}}{\text{L}} \right)} \times \frac{10^6 \text{ mg}}{\text{Kg}} \times \frac{\text{mg}}{10^3 \text{ ng}}$$

Generally speaking, water samples should be grouped for analysis according to the region of the river from which they are derived. The sample groups for analyzing water column PCB distributions for both transect and flow-averaged samples are shown below.

Water Column and Flow-Averaged Sample Groups for Determining Frequency of Non-Detected PCB Congeners

Group	Station Number [1]	River Mile Range
Upper River	3, 4, 5, 6, 7, 8, 19	195.8 to 156.6
Lower River Freshwater [2]	14, 15, 16, 17	153 to 77
Lower River Saline	none	
Background & Tributaries [3,4]	1, 2, 11, 12, 13	
Lock 7 [5]	10	potential source

^[1] Station 9 (Saratoga Springs) was used to assess sampling and laboratory contamination and should not be used in any sample grouping.

^[2] Station 0014 (Troy at Green Island Bridge) was monitored to represent the mixture of the Mohawk (0013) and Waterford (0008). These Lower Hudson stations were monitored during three of the eight water column transects.

^[3] Quantitation of contaminants in these samples is questionable because the levels approach the detection limit. While there are sources of PCBs in the river upstream of Fenimore Bridge, these samples represent applicable background conditions for the river downstream of that point.

^[4] These stations represent three different watersheds and should generally be considered separately.

^[5] The Champlain Canal above Lock 7 represents a potential source to the river, but flow rates through the lock are negligible; therefore fluxes are expected to be small or negligible.

2.5.2 Confirmatory Sampling Study

Confirmatory sampling results are intended for use with the geophysical investigation of the Upper Hudson, specifically the side-scan sonar survey. Since the geophysical techniques recorded physical river bottom properties, specifically reflectivity, there is a need to calibrate the geophysical signals obtained with a set of analytical measurements. The sediment samples collected in this study have been analyzed for several parameters useful for mapping sediment characteristics. Figure 2-15 shows the confirmatory sediment sampling locations.

General Comments

Confirmatory sample results are found under the *PHASE2\SEDIMENT* subdirectory. Confirmatory samples are designated with a "CC-" or a "CG-" at the beginning of the **TAMS ID** specifying a core or grab sample, respectively. The middle three digits indicate the station number and the last four digits indicate the core depth interval in centimeters. For example, CC-080-0510 is a sample from a confirmatory core at station 80 collected from the core interval between 5 and 10 cm. These samples provide information on the spatial distribution of sediment properties from Bakers Falls to Lock 5. Northing and easting must be used to isolate samples among the various study areas since the areas were not sampled sequentially. Sample duplicates were collected, representing laboratory duplicates, field split samples and co-located field samples. Results of co-located duplicate pair analyses and laboratory duplicates have been averaged for use in data analysis. Field split samples have not been averaged. Individual sample analyses used in calculating the average values are found in sample duplicate tables. The results representing averaged values are indicated by the entry in the **Split** field within the data tables. The key to the **Split** field can be found in the **PARAMS** glossary. Some confirmatory samples are labeled with an "X" in the **TAMS Type** field. These samples represent cores subjected to X-radiography.

The main river section of consideration for the confirmatory samples extends from Rogers Island to Lock 5. Samples collected from river zones from Rogers Island to Lock 5 (which includes the Thompson Island Pool) can be considered representative of the river sediments in this area. These samples can be grouped together to obtain mean properties for this river section on a spatial basis. The best large-scale spatial interpolation of these values can be made using the side-scan sonar interpretation maps created as part of the geophysical investigation in a geographic information system (GIS).

Confirmatory samples collected from the Bakers Falls pool, that is, from above Bakers Falls near the Fenimore Bridge, do not represent the local characteristics. The river bottom in the area is mostly bedrock, while the samples were obtained from relatively fine-grain sediments from a few peripheral areas due to sampling access limitations. The samples are only representative of the small zones of fine-grained sediments in this area. The zone below Bakers Falls and above Rogers Island, *i.e.*, the remnant deposit area, has unique sedimentological characteristics based on sediment samples and the hydrological conditions noted there. The grain size distributions obtained from the samples in this area may be biased. The physical sample sizes were too small to ensure a statistically representative data set since this zone contains some areas with gravel and cobbles which could not be sampled. These samples should reflect the basic characteristics of the sandy sediments in this zone.

Grain Size Distribution Analysis

In general, the grain size distribution data from the confirmatory sampling program can be used for qualitative analysis but *not* quantitative analysis. Due to the relatively small sample size (*i.e.*, 200 to 500 g samples) and the frequent occurrence of gravel-sized particles, a potential uncertainty exists in the ratio of the gravel fraction to the sand and finer fractions. This matter will

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be discussed at length in the data usability section of the Data Evaluation and Interpretation Report. In the Confirmatory Sampling Program, both the sieve and laser particle analyses were performed on comparable sample sizes (i.e., 200 to 500g). However, the data user is cautioned against combining the sieve and laser particle analysis data directly due to possible systematic differences in the results from the two techniques. The analysis name is included in the parameter so as to remind the user that the data are derived from two distinct methods (e.g., clay % (sieve) and clay % (laser)). Paired sieve and laser particle analyses provide a point of reference for direct comparison between the measurement techniques. For internal consistency, TAMS/Gradient recommends using the laser grain size data to characterize the river bed.

Total Carbon/Total Nitrogen and Total Inorganic Carbon

These data can be used to derive a close approximation of the total organic carbon (TOC) of the sediments by subtracting the total inorganic carbon (TIC) from the total carbon (TC). These results have been designated in the database as "TOC (calculated)." Rules for the calculations are given below. The TIC is generally negligible so that TC and TOC (calculated) were nearly identical. Total nitrogen (TN) can be used with total carbon as an indicator of wood cellulose (wood chips) in the sediments. A high C to N ratio (C/N) implies high cellulose content.

TOC Calculation Rules

TC	TIC	TOC (calculated)
Null	Value	No calculation possible
Value	Null	Assume TOC = TC
Value	Non-detect	Assume TOC = TC
Non-detect	Non-detect	Assume TOC = non-detect
Value	Value	$TC - TIC = TOC$

Sediment Description

As part of the confirmatory sample collection process, sediment samples were classified according to the TAMS field classification procedures. These procedures are based on the ASTM visual description and identification of soils methodology. The TAMS field procedures were used to describe the sediment samples on the basis of the ASTM standard soil classification. In addition, reduction-oxydation potential (redox) was measured for most samples. The sediment classification and redox data are contained in the **SEDESC** table. The terms used in the sediment descriptions are defined in the **PARAMS** glossary.

2.5.3 High-Resolution Sediment Coring Study

High-resolution core data can be found in the *PHASE2\HRCORES* subdirectory. High-resolution sediment core samples are designated by the initial letters "HR" in the **TAMS ID**. The PCB profiles recorded in the high-resolution sediment cores provide an historical record of water column transport by suspended matter and do not provide a spatial representation of sediment PCB contamination in the river. The term "high-resolution" refers to the fine slicing intervals used in subdividing these cores. A listing of core sites follows; Figures 2-16A and 2-16B show the Upper and Lower coring sites, respectively.

High-Resolution Sediment Cores

River Mile	Location	Core No.	Station ID
202.9	Background - Bishop's Dock	27	HR-027
197.1	Bakers Falls	28	HR-028
194.1E	Rogers Island East	26	HR-026
194.2W	Rogers Island West	25	HR-025
191.2	Thompson Island Pool	20	HR-020
189.3	Thompson Island Pool	23	HR-023
188.5	Thompson Island Dam	19	HR-019
185.8	Above Lock #5	18	HR-018
(NA)	Batten Kill #2	17	HR-017
177.8	Stillwater Pool	22	HR-022
177.8	Stillwater Pool	21	HR-021
166.3	Above Lock #3	16	HR-016
(NA)	Hoosic #4	24	HR-024
159.0	Below Lock #1	15	HR-015
(NA)	Mohawk	12	HR-012
143.5	Albany Turning Basin	11	HR-011
124.1	Stockport	14	HR-014
99.2	Tivoli Bay	13	HR-013

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High-Resolution Sediment Cores (Cont'd)

River Mile	Location	Core No.	Station ID
88.5	Kingston	10	HR-010
59.6	Denning's Point	9	HR-009
54.0	Foundry Cove	8	HR-008
43.2	Lent's Cove	7	HR-007
43.2	Lent's Cove	6	HR-006
25.0	Piermont Marsh	1	HR-001
2.4	Mid-Harbor	4	HR-004
(NA)	Newtown Creek (NC 7)	5	HR-005
-1.9	Upper NY Bay	2	HR-002
-2.2	Upper NY Bay	3	HR-003

High-resolution cores are labeled in a similar manner to the confirmatory cores. The middle three digits contain the coring location site number. The last four digits in the sample identifier capture the core depth interval in centimeters. For instance, HR-001-0406 is a sample from a core at station 1 (Piermont Marsh) taken from the 4- to 6-cm depth interval.

High-resolution core intervals with field duplicate analyses are indicated by a "D" in the **TAMS Type** field. Field duplicate samples were collected from a single core slice but were *not* homogenized prior to analysis and thus are considered co-located samples. Duplicate high-resolution cores, co-located cores, *i.e.*, Nos. 6 and 7 and Nos. 21 and 22, are duplicate core pairs for the dating analysis. A comparison of these cores will be discussed in the Data Evaluation and Interpretation Report to be published in the near future. Individual slices of these cores *cannot* be compared as field duplicate samples (*e.g.*, HR-006-2024 and HR-007-2024) due to potential differences in the sedimentation rates between the cores.

As part of the high-resolution sediment core collection process, four cores were collected at each site. These are labeled P, A, G, X in the **TAMS Type** field. These four cores were closely co-located at each coring site. They were necessary because of the limited material for sample analysis available in an individual core. The "P" or primary core was sliced and subdivided into 2- to 4-cm layers and used for PCB, TC/TN, TOC and radionuclide analysis. Thicker layers (*i.e.*, 4-cm layers) were also used to provide material for small volume (2cc) laser particle analyses. The "A" or archive core was used to provide material for small volume laser grain size analyses for the 2-cm slice intervals spanning 0-8 cm in the core, as well as to provide an archive in case additional sediment analyses were needed. In a limited number of cases, the 0-

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to 2-cm and 2- to 4-cm slices from these cores were analyzed for PCBs and radionuclides. The "G" or grain size analysis core was used to provide a large volume laser grain size sample, typically integrating the equivalent of 2 to 4 layers in the "P" core. It was also used to provide a large sample for PCB congener laboratory quality control. The remaining core, labeled "X" for x-ray was intended for x-ray photography to examine sediment structure; however, x-ray photography was not performed for high-resolution cores.

Supplemental core tops, *i.e.*, 0- to 2-cm intervals, are available for a number of locations. These cores were collected prior to the main Phase 2 coring effort as part of the site selection process. These core tops are assigned core numbers 29 through 35 and are labeled with a final "A" in the **TAMS Type** field of the database. In addition, several core tops were collected in April 1992 from very high deposition zones in the saline Lower Hudson such as boat basins, and analyzed for PCBs and radionuclides. These samples are identified as cores 36 through 39, also labeled with an "A." For all samples labeled with an "A," it should be noted that the PCB analyses were performed on dried sediments beyond the standard seven-day holding time. The table below describes these samples.

Supplemental High-Resolution Core Top Samples

TAMS Sample ID	LDEO No.	River Mile	Corresponding Core (and RM)	Location
HR-029-0002A	2163A		12	Mohawk #3
HR-029-0002D	2163A		12	Mohawk #3
HR-030-0002A	2133A	99.2	13 (99.2)	Tivoli Tsc
HR-031-0002A	2152A	124	14 (124.1)	Stockport Sfe
HR-032-0002A	2178A	159.0	15 (159.0)	159.0
HR-033-0002A	2175A		17	Batten Kill
HR-034-0002A	2219A	194.2	25 (194.2W) and 26 (194.1E)	Rogers Island
HR-035-0002A	2220A	194.3	25 (194.2W) and 26 (194.1E)	Rogers Island
HR-036-0002A	2126A	6.27		Lower Hudson Boat Basin
HR-037-0002A	2123A	12.9		Lower Hudson Boat

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Supplemental High-Resolution Core Top Samples (Continued)

TAMS Sample ID	LDEO No.	River Mile	Corresponding Core (and RM)	Location
				Basin
HR-038-0002A	2124A	13.25		Lower Hudson Boat Basin
HR-039-0002A	2121A	17.9		Lower Hudson Boat Basin

PCB Congener Analysis

Identifiers for high-resolution sediment core samples with associated PCB congener data contain a "P" in the **TAMS Type** field with few exceptions. Those samples labeled with a "G" should not be used since these are quality control samples; these samples represent large core slice intervals from co-located cores without any radionuclide information. High-resolution sediment cores *should not be grouped collectively* into one large data set for data analysis due to major differences in *in-situ* conditions, local PCB loadings and variations in sediment deposition rates. Core samples ending with an "A" with associated PCB results generally represent core slices from the 0- to 2-cm interval in a supplemental high-resolution core given in the table above.

For all cores in the above table, information on the beryllium-7 and cesium-137 levels in the core interval is also available. For the supplemental cores collected in the Upper Hudson, these "A" samples were analyzed for PCBs and radionuclides because the beryllium-7 levels in the comparable "P" core slice were not detectable.

The PCB congener data include averaged co-located sample pairs identified by the **Split** field in the **PCBS** database table. The original duplicate pair results can be found in the **PCBSD** database table.

For the calculation of the **Value2** and the homologue, total PCBs and Aroclor sums, the high-resolution core results were grouped geographically, as previously described in Section 2.5. The sample grouping used for determining frequency of non-detected PCB congeners is provided below.

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High-Resolution Sediment Core Sample Groups for Determining Frequency of Non-Detected PCB Congeners

Group	Core Numbers	River Mile
Upper River	15, 16, 18, 19, 20, 21, 22, 23, 25, 26, 28, 32, 34, 35	197.3 to 156
Lower River freshwater	10, 11, 13, 14, 30, 31	153 to 60.1
Lower River saline	1, 2, 3, 4, 5, 6, 7, 8, 9, 36, 37, 38, 39	60 to -2
Background and tributaries	12, 17, 24, 27, 29, 33	

Conventional Parameters

All conventional parameters are stored in the table **NONPCBS** except for the radionuclide data which resides in **RADNUC**. For information regarding total carbon/total nitrogen and total inorganic carbon refer to the discussion in Section 2.5.2 concerning the confirmatory sampling program. All high-resolution sediment core grain size analyses were performed using the laser particle method. However, there were two sample types: small-volume (SV) and large-volume (LV).

The LV samples provide an accurate, unbiased representation of grain size distribution (*i.e.*, percent gravel, sand, silt, and clay). It should be noted, however, that these samples represent 8-cm slices from 0 to 8 cm in depth as noted in the **TAMS ID** field. These samples were obtained exclusively from the "G" core. There is one LV sample per core except for core 25. All other high-resolution grain size samples are SV samples and should only be used to represent differences in the fine-grained fraction (silt, clay and possibly sand) among samples. These samples have a "P" or an "A" in the **TAMS Type** field. Core samples for grain size distribution analysis were obtained from the co-located "A" core for the upper four core slices, *i.e.*, intervals 0 to 2, 2 to 4, 4 to 6, and 6 to 8cm, because of sample volume limitations. The remaining SV samples were collected from the "P" core. Because of the general homogeneity of sediment in an individual high-resolution core, the grain size distribution results from the "A" core can be correlated with the other analyses for the corresponding "P" core intervals without additional correction. Total organic nitrogen data were obtained for a subset of the high-resolution core samples. All TON samples were obtained from the core intervals below eight centimeters because of sample volume limitations. The TON values measured by Chemtech do not correspond well to the total nitrogen values measured by the Lamont-Doherty Earth Observatory method which may be partially due to the differences in analytical techniques.

Measurements of radionuclides in high-resolution core sediments, including ^{134}Cs , ^{137}Cs ,

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^7Be , and ^{60}Co , were provided by Lamont-Doherty Earth Observatory. There were no field co-locates or splits for these samples. These data are reported with the measured value as well as a counting error representing a one standard deviation error. In general, the reported value must be greater than two standard deviations to be considered a detection.

2.5.4 Low-Resolution Sediment Coring Program

The low-resolution sediment coring program took place during July and August 1994. Figures 2-17A through 2-17D show these coring locations.

The results of the low-resolution sediment coring program are contained in the *PHASE2\SEDIMENT* subdirectory along with the confirmatory sample results. Both data sets can be used to characterize the sediments of the Upper Hudson. Samples collected for the low-resolution coring program are labeled with an initial "LR" or "LH" and generally follow the other sediment core naming schemes. The "LR" refers to cores collected in the Thompson Island Pool. The "LH" refers to cores collected in *hot spot* areas below the Thompson Island Dam. The middle three digits in the **TAMS ID** refer to the core location. The first two digits give the coring site or cluster and the last digit, a letter, refers to the location within the cluster. For LR samples, the core site refers to Phase 2 coring clusters and has no relationship to any specific *hot spot*. For the LH samples, the site number refers to the original NYSDEC *hot spot* number (Numbers 25 to 40). There are also several LH sites with numbers greater than 40. These represent additional sites sampled during the program.

The last four digits of the **TAMS ID** refer to the sediment sampling depth. However, due to the extensive length of the low-resolution cores, these digits represent inches, not centimeters as in the other core identifiers. For example, LR-10D-0001 represents the sample from the fourth core (D) collected in the Thompson Island Pool at cluster 10 obtained between 0 (00) and 1 inch (01) of depth. LH-25A-0816 represents the sample from the first core collected at *hot spot* 25 obtained between 8 and 16 inches of depth.

The letters "D" and "M" are used in the **TAMS Type** field. "D" signifies a field split sample. These sample results are located under the *PHASE2\SEDIMENT\QA_QC* subdirectory in the tables **PCBSD**, **LASERGSD** and **SIEVEGSD**. Field splits are not averaged. The "M" indicates the sample was collected for laboratory quality assurance in addition to its regular purpose. These sample results can be used as regular analyses.

It is important to note that the locations for the confirmation and low-resolution core sites were surveyed in place by licensed surveyors. The coordinates reported for all other programs represent estimates made from various maps and are of lesser accuracy.

Analytical Results

PCB congener results are reported in **PCBS** and **PCBSD** in the *PHASE2\SEDIMENT* subdirectory following the same PCB result summation process described for the water column and high-resolution coring program. The low-resolution coring data were considered to be one group for the treatment of non-detect results.

As part of the low-resolution coring program, samples were analyzed for PCB congeners, grain size distribution by both laser particle and sieve techniques, radionuclides and total organic carbon. Bulk density was determined for the sample by directly weighing a measured volume in the field. Particle density was determined using the bulk density result and the percent solids measurement determined on a large fraction of the sample. Like the confirmatory samples, both grain size data and descriptive data are available to characterize the low-resolution core sediments. Grain size data are available for all low-resolution core tops based on laser particle analysis. Grain size distributions based on the standard sieve and hydrometer analysis are available for about 150 samples. Reduction-oxidation (Redox) data are available for some low-resolution cores. In total, these data will be used to characterize the sediments of the Hudson as well as to compare current conditions with those measured by previous studies, particularly the 1984-1985 NYSDEC sediment survey.

2.5.5 Ecological Program

The Ecological Program under Phase 2 included a field investigation which took place in August and September 1993. The ecological field results are located in the *PHASE2\ECO* subdirectory; the sampling stations are shown in Figures 2-18A and 2-18B for the Upper and Lower Hudson, respectively.

The ecological field investigation involved the collection of fish, benthic invertebrates, and sediments from 20 sites located throughout the Hudson River (See Table 2-10). Five sites were within the Thompson Island Pool. At each sampling site various combinations of fish, benthic invertebrates and sediments were collected, generating up to five co-located samples per medium per site. Fish and benthic invertebrate samples were classified and sorted by species prior to analysis. In some cases, benthic invertebrate species were recombined into total benthic invertebrate samples. Data were obtained for the fish and benthic invertebrate samples defining the individual and average animal length and weight.

Ecological samples can be identified by an initial "EC" in the **TAMS ID**. The next digit refers to the matrix: "F" for fish, "B" for benthic invertebrate, and "S" for sediment. The fourth and fifth digits define the station number 1 through 20. The last four digits define the co-located number for the sample. The second identification field, **TAMS Type**, is used to indicate field split samples for the benthic invertebrate and sediment samples. No field splits or co-locate samples were obtained for the fish analysis program. Sediment and benthic invertebrate field split samples are labeled with a "D." The samples labeled with an "M" are laboratory quality assurance

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samples but the data are of equal quality to any other result. Because of the additional complexity of animal species information, a third field, **Species**, was added to the ecological sample identification. In the database tables, the species are represented by a four-letter code. The key for the species code will be found in the **SPECIES** data table in the *Phase2\ECO* subdirectory. Two examples of the ecological sample ID are given here. EC-F03-0002 represents the second co-located sediment sample collected at ecological station 3. EC-B05-0004-IS represents the fourth co-located benthic invertebrate sample from station 5 consisting of isopods.

In a limited number of cases, the benthic co-located samples from a given site did not contain sufficient material to generate a sample. In these cases, two samples were composited. These are noted in the last four digits of the **TAMS ID** field whereby the first two digits give the first co-located sample number and the second two digits give the second co-located sample number. For example, EC-B12-0203 represents the composite of co-locate numbers 2 and 3 from ecological sampling site 12.

Note that the co-locates for each medium do not match exactly, *i.e.*, co-locate number 1 for sediment must not be matched to co-locate number 1 for benthic invertebrates. Instead, co-locates for each matrix should be compared as a single unit to co-locates in another matrix for the same site. In general, due to the inherent difficulties in fish collection, the area represented by the sediment and benthic invertebrate samples for a given station was smaller than that for the fish sample.

Analytical Results

PCB congener analyses were performed on fish, benthic invertebrates and sediment samples. Every station did not, however, have samples from all three matrices. PCB results were tabulated in **Value1**, **Value2** and the various sums described in previous sections. However, due to improvements in the analytical techniques, an additional 13 congeners were added to the list of reported PCB congeners. These 13 were ignored for the purpose of generating homologue, total PCB and Aroclor sums so as to maintain consistency across the entire Phase 2 data set.

In addition to PCB congener analyses, data were obtained on percent lipid content, animal weight and length for fish samples. Fish samples were analyzed by species. For the benthic invertebrate samples, percent lipid content and total sample mass weight were measured. Benthic invertebrate samples were analyzed by species when sufficient individuals were present. Species composite samples were also run. Sediment analyses included total organic carbon, laser particle grain size distribution, and metals.

The data pertaining to non-PCB analyses are located in the *PHASE2\ECO* subdirectory in the **NONPCBS** and **NONPCBB** tables for sediment and biota data, respectively. Specific fish and benthic invertebrate sample information such as length can be found in the **FISH** and **BENTHIC** database tables. Sample groupings for the purpose of dealing with non-detect results can be found in the **GROUPS** data table.

2.5.6 Calculated Flow Data

Flow measurements at the USGS stations at Waterford and Stillwater were not available in 1993 due to construction in these areas during this time period. As a result, flow at these locations had to be estimated from other available data. The creation of the flow estimates is documented in the Data Evaluation and Interpretation Report. In general, flows were estimated based on the reported flow at Fort Edward and the staff gauge readings collected at the locks of the Upper Hudson. Calculated flow data are contained in the table **FLOW93** in the *PHASE2\FLOW* subdirectory.

Flows were calculated for January through September 30, 1993 for the Hudson River at both Stillwater and Waterford. The data table also contains two additional fields indicating the specific model used to calculate a given day's flow. Several flow calculation models were used for each station to allow each day's flow to be calculated with all available data for that day. The details of the models are provided in the Data Evaluation and Interpretation Report.

Since the creation of these flow estimates, the USGS has released its own estimate of flow at these locations. These estimated flows are included in the database tables under the *USGS* subdirectory. However, all flow and transport analyses conducted for 1993 for the Reassessment utilize the flow estimates contained in **FLOW93**.

2.6 NOAA Ecological Sampling Program

During the ecological field investigation, additional fish samples were obtained by the field crew and provided to the National Oceanic and Atmospheric Agency (NOAA). These samples were intended to supplement the Phase 2 ecological investigation. These samples represent fish from 10 of the 20 ecological sampling sites.

The NOAA results are in the *NOAA* subdirectory. Because they were collected during the Phase 2 investigation, they have been labeled in the same manner as the Ecological Program samples. In fact, the structures of the sample identification fields (**TAMS ID**, **TAMS Type** and **Species**) as well as the data table structures themselves are identical to the Phase 2 ecological data set. The **TAMS Type** field is labeled with an "N" to indicate that these samples were analyzed by NOAA.

The samples were analyzed for PCB congeners by the same laboratory and technique used for the Phase 2 investigation. In this manner, the data are analytically identical to that of Phase 2. The only analytical difference arises from the data validation. NOAA samples will be validated to NOAA standards while the Phase 2 data are validated to USEPA standards. This difference is unlikely to affect the comparability of the data sets. The PCB congener results were treated identically to that of the Phase 2 data, with **Value1**, **Value2** and the congener sums generated in the same manner.

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In addition to PCBs, data were obtained for percent lipid content, animal length, and weight for the NOAA samples. The percent lipid data are located in the **NONPCBB** table. In addition, the animal length and weight data are located in the **FISH** table.

2.7 Aroclor Standard Analysis

As part of the Phase 2 analytical program, analytical standards representing six Aroclor mixtures were obtained from ULTRA Scientific of North Kingstown, RI and AccuStandard, Inc. of New Haven, CT. These standards represented Aroclors 1221, 1232, 1242, 1248, 1254 and 1260.

The analyses were performed by the contract laboratory on three separate occasions, once in September 1992 and twice in April 1994, using the same analytical system as used for the Phase 2 PCB congener analyses. These results were used to characterize the Aroclors on a congener-specific basis. This information in turn became the basis for assigning individual congeners to each Aroclor for the purpose of determining Aroclor concentrations in Phase 2 samples.

The results of the Aroclor standard analyses are contained in the file **AROCLSTD** under the *PHASE2* directory. The criterion for assigning a congener to an Aroclor was based on mass percentage. Specifically, if a congener represented 0.1% or more of the mass in a given Aroclor, it was included in the Aroclor concentration estimate (or sum). The results of applying this criterion to the Aroclor standard analyses are summarized in the table **ASCREEN** in the *PHASE2* directory. This table shows the assignments of each congener to the six Aroclor standards. The table is structured as a matrix of congener number by Aroclor standard. When the congener is assigned to a specific Aroclor, a value of unity is placed in the corresponding cell. When a congener is not considered present in the Aroclor standard, the cell is left blank.

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Table 2-1
Studies Relating to PCB Contamination in the Hudson River^a
Page 1 of 2

Type of Assessment	Year(s)	Location	Investigators
<i>Sediment Surveys</i>			
C 40-Mile Region of the Hudson River (>1,000 samples)	1976 - 1978	Fort Edward to Albany; Some Lower Hudson	NYSDEC
C Approx. 9-Mile Reach	1983	Thompson Is. Pool/Other	USEPA
C Approx. 5-Mile Reach (>2,000 samples)	1984	Thompson Is. Pool	NYSDEC
C Selected Upper & Lower Hudson Areas (Dated Core Samples)	1974 -1986	Upper and Lower Hudson	Lamont-Doherty
C Selected Upper Hudson Areas (Confirmatory Sediment Samples)	1992	Upper Hudson/ Rogers Is. to Lock 5	USEPA/TAMS
C Selected Upper and Lower Hudson Areas (28 High-Resolution Sediment Coring Sites)	1992	Upper and Lower Hudson	USEPA/TAMS
C Selected Upper and Lower Hudson Areas (20 Ecological Survey Sediment Samples)	1993	Upper and Lower Hudson	USEPA/TAMS
C Selected Upper Hudson Areas (Low-Resolution Sediment Core Samples)	1994	Upper Hudson/ Rogers Island to Lock 2	USEPA/TAMS
<i>River Flow & Water Quality</i>			
C River Flow (Discharge)	1908 - Present	Upper Hudson Region to Hadley	USGS
C Water Quality/Suspended Sediment/PCBs	. 1975 - Present	Hadley to Green Island	USGS
C Water Levels	1916 - Present	Upper Hudson/ Champlain Canal	NYSDOT
C Dissolved and Particulate Phase PCBs	1983	Upper Hudson	Lamont - Doherty/NYSDEC
C Dissolved and Particulate Phase PCBs	1993	Upper Hudson	USEPA/TAMS
C Total Suspended Solids	1993 - 1994	Upper Hudson	USEPA/TAMS
<i>Fish/Biota</i>			
C Fish Samples Prior to GE Hearings	1970 - 1975	Upper and Lower Hudson	NYSDEC, USEPA, NYSDOH

Table 2-1
Studies Relating to PCB Contamination in the Hudson River^a
Page 2 of 2

Type of Assessment	Year(s)	Location	Investigators
<i>Fish/Biota (cont'd)</i>			
C Fish Collection/Analysis Program	1975 - Present	Upper and Lower Hudson	NYSDEC
C Archived Fish Analysis	1978 - 1982	Upper and Lower Hudson	GE
C Macroinvertebrate	1973 - 1985	Upper and Lower Hudson	NYSDOH
C Fish and Macroinvertebrate Collection/Analysis 1993 Program		Upper and Lower Hudson	USEPA/TAMS
<i>Air</i>			
C Air Monitoring	Late 1970s - Early 1980s	Fort Edward and Dump Sites	NYSDEC/DOH and Boyce Thompson Inst.
C Air Monitoring	1986-1987	Fort Edward Area	NYSDEC
<i>Plant/Crop Uptake</i>			
C Tree species/Some Crop and Forage Plants	Early 1980s	Fort Edward Area, Dump Sites, Dam Tailwater	NYSDEC/Boyce Thompson Inst.
C Perennial and Crop Plants	1984 - 1985	Hudson River/Albany Area	NYSDOH
<i>Groundwater</i>	1977	Dredge Spoils	NYSDEC/Weston
<i>Baseline Remnant Deposit Containment Studies and Current GE Investigations</i>			
C Water Column	1989 - Present	Upper Hudson Locations	GE
C Sediment	1989 - 1994	Upper Hudson Locations	GE
C Air Monitoring	1989 to Present	Remnant Deposits Area and Fort Edward	GE
C Multiplate/Biota	1989	Near Remnant Deposits	GE

Notes:

^aAdapted from Limburg *et al.* (1986).

Table 2-2
Data Sets in the Reassessment Database Organized by Matrix
Page 1 of 2

Type of Assessment	Year(s)	Location	Investigators (SUBDIRECTORY)
<i>Sediment Surveys</i>			
C Over 40-Mile Reach (>1,000 samples)	1976 - 1978	Fort Edward to Albany; Some Lower Hudson	NYSDEC (HISTORIC\SED)
C Approx. 5-Mile Reach (>2,000 samples)	1984	Thompson Is. Pool	NYSDEC (HISTORIC\SED)
C Selected Sites (3 Cores)	1977 - 1986	Upper and Lower Hudson	Lamont-Doherty (LDEO)
C Selected Upper & Lower Hudson Sites	1989 - 1993	Upper Hudson Locations	GE (GE and HISTORIC\SED)
C Selected Upper Hudson Areas (Confirmatory Sediment Samples)	1992	Upper Hudson/Bakers Falls to Lock 5	USEPA/TAMS (PHASE2\SEDIMENT)
C Selected Upper & Lower Hudson Areas (28 High-Resolution Sediment Core Sites)	1992	Upper & Lower Hudson	USEPA/TAMS (PHASE2\HRCORES)
C Selected Upper & Lower Hudson Areas (20 Ecological Survey Sediment Sites)	1993	Upper & Lower Hudson	USEPA/TAMS (PHASE2\ECO)
C Upper Hudson Areas (Low-Resolution Sediment Core Samples)	1994	Ft. Edward to Lock 2	USEPA/TAMS (PHASE2\SEDIMENT)
<i>River Flow & Water Quality</i>			
C River Flow (Discharge)	1908 - 1993	Upper Hudson Region to Hadley	USGS (USGS\FLOW)
C River Flow (Discharge: Calculated)	1993	Ft. Edward to Waterford	USEPA/TAMS (PHASE2\FLOW)
C Champlain Canal Water Levels	1977 - 1993	Upper Hudson	NYSDOT (NYSDOT)
C PCB/Water/Sediment Partitioning	1986	NA	Lamont-Doherty (LDEO)
C Water Quality/Suspended Sediment/PCBs	. 1975 - Present	Hadley to Green Island	USGS (USGS\WQDATA)
C Dissolved & Particulate Phase PCBs	1993	Upper Hudson	USEPA/TAMS (PHASE2\WATER)
C Total Suspended Solids	1993 - 1994	Waterford Only (1993); Upper Hudson (April 1994)	USEPA/TAMS (PHASE2\WATER)
C Water Quality	1989 - 1994	Upper Hudson Locations	GE (GE)

Table 2-2
Data Sets in the Reassessment Database Organized by Matrix
Page 2 of 2

Type of Assessment	Year(s)	Location	Investigators (<i>SUBDIRECTORY</i>)
<i>Fish/Biota</i>			
C Fish Collection/Analysis Program	1976 - 1993	Upper and Lower Hudson	NYSDEC (<i>HISTORIC\FISH</i>)
C Macroinvertebrate	1976 - 1985	Upper and Lower Hudson	NYSDOH (<i>HISTORIC\MACROINV</i>)
C Archived Fish Analysis	1978 - 1982	Upper Hudson	GE (<i>GE</i>)
C Fish & Macroinvertebrate Collection/Analysis Program	1993	Upper and Lower Hudson	TAMS/USEPA (<i>PHASE2\ECO</i>)
C Multiplate/Biota	1989	Near Remnant Deposits	GE (<i>GE</i>)
C Supplementary Fish Analysis (to the Ecological Program)	1993	Upper and Lower Hudson	NOAA (<i>NOAA</i>)

Table 2-3
Data Sets in the Reassessment Database Organized by Directory
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Data Sets in the *HISTORIC* Directory of the Interim Database Release

Type of Assessment	Year(s)	Location	Investigators (<i>SUBDIRECTORY</i>)
<i>Sediment Surveys</i>			
C 40-Mile Region of the Hudson River (>1,000 samples)	1976 - 1978	Fort Edward to Albany; Some Lower Hudson	NYSDEC (<i>HISTORIC\SED</i>)
C Approx. 5-Mile Reach (>2,000 samples)	1984	Thompson Is. Pool	NYSDEC (<i>HISTORIC\SED</i>)
C Sediment - Selected Hudson River Sites	1989 - 1991	Upper Hudson Locations	GE (<i>HISTORIC\SED</i>) ^[1]
<i>Fish/Biota</i>			
C Fish Collection/Analysis Program	1973 - 1993	Upper and Lower Hudson	NYSDEC (<i>HISTORIC\FISH</i>)
C Macroinvertebrate	1973 - 1985	Upper and Lower Hudson	NYSDOH (<i>HISTORIC\MACROINV</i>)

[1] GE data can be found in the GE89 as well as the other files in this subdirectory.

Data Sets in the *GE* Directory

Type of Assessment	Year(s)	Location	Investigators (<i>SUBDIRECTORY</i>)
<i>Baseline Remnant Deposit Containment Studies and Current GE Investigations</i>			
C Suspended Solids/PCBs	1989 - 1994	Upper Hudson Locations	GE (<i>GE</i>)
C Sediment - Selected Hudson River Sites	1991 - 1993	Upper Hudson Locations	GE (<i>GE</i>)
C Multiplate/Biota	1989 - 1992?	Near Remnant Deposits	GE (<i>GE</i>)
C Archived Fish Samples - Selected Hudson River Sites	1978-1982	Upper and Lower Hudson	GE (<i>GE</i>)

Table 2-3
Data Sets in the Reassessment Database Organized by Directory
Page 2 of 3

Type of Assessment	Year(s)	Location	Investigators (SUBDIRECTORY)
<i>River Flow & Water Quality</i>			
C River Flow (Discharge)	1908 - 1993	Upper Hudson Region to Hadley	USGS (<i>USGS\FLOW</i>)
C Water Quality/Suspended Sediment/PCBs	. 1975 - 1994	Hadley to Green Island	USGS (<i>USGS\WQDATA</i>)

Data Sets in the LDEO Directory

Type of Assessment	Year(s)	Location	Investigators (SUBDIRECTORY)
<i>Sediment Surveys</i>			
C Selected Hudson Sites (3 Cores)	1977 - 1986	Upper and Lower Hudson	Lamont-Doherty (<i>LDEO</i>)
<i>River Flow & Water Quality</i>			
C PCB Sediment/Water Partitioning	1986	NA	Lamont-Doherty (<i>LDEO</i>)

Data Sets in the NOAA Directory

Type of Assessment	Year(s)	Location	Investigators (SUBDIRECTORY)
<i>Fish/Biota</i>			
C Supplementary Fish Analysis (to the Phase 2 Ecological Program)	1993	Upper and Lower Hudson	NOAA (<i>NOAA</i>)

Data Sets in the NYSDOT Directory

Type of Assessment	Year(s)	Location	Investigators (SUBDIRECTORY)
<i>River Flow & Water Quality</i>			
C Champlain Canal Water Levels	1975 - 1993	Upper Hudson	NYSDOT (<i>NYSDOT</i>)

Table 2-3
Data Sets in the Reassessment Database Organized by Directory
Page 3 of 3

Data Sets in the PHASE 2 Directory

Type of Assessment	Year(s)	Location	Investigators (SUBDIRECTORY)
<i>Sediment Surveys</i>			
C Selected Upper Hudson Areas (Confirmatory Samples)	1992	Upper Hudson/Bakers Falls to Lock 5	USEPA/TAMS (PHASE2\SEDIMENT)
C Selected Upper Hudson Areas (Low Resolution Coring)	1994	Upper Hudson/Ft. Edward to Lock 2	USEPA/TAMS (PHASE2\SEDIMENT)
C Selected Upper and Lower Hudson Sites (28 High Resolution Sediment Core Sites)	1992	Upper and Lower Hudson	USEPA/TAMS (PHASE2\SEDIMENT)
C Selected Ecological Program Sampling Areas	1993	Upper and Lower Hudson	USEPA/TAMS (PHASE2\ECO)
<i>River Flow and Water Quality</i>			
C Total Suspended Solids and Suspended Organic Matter	1993 - April 1994	Waterford (1993) Upper Hudson (April 1994)	USEPA/TAMS (PHASE2\WATER)
C Dissolved and Particulate Phase PCBs	1993	Upper Hudson	USEPA/TAMS (PHASE2\WATER)
C River Flow (Discharge: Calculated)	1993	Upper Hudson	USEPA/TAMS (PHASE2\FLOW)
<i>Fish/Biota</i>			
C Fish and Macroinvertebrates Collection/Analysis Program	1993	Upper and Lower Hudson	USEPA/TAMS (PHASE2\ECO)

Table 2-4
Sediment Sample Inventory From the
1984-1985 NYSDEC Hudson River Survey

Sediment Samples						
	Hudson River Reassessment Database			Reported by Brown et. al, 1988		
	Grab Samples Sites	Cores Sites		Grab Samples Sites	Core Sites	
Original Sites	675 ^[1]	408		607	407	
Co-Located Samples	23	1				
Field Relocates	6					
Total Sites	704	409 ^[2]		607	407	
Field Duplicates ^[3]	29	25				
Total Samples	733	1315 ^[4]		607	1312 ^[4]	
Total Sample Records	2048			1919		
PCB Analyses						
	No. of Analyses			No. of Analyses		
	Grab Samples	Core Samples	All Samples			
GC/MS Result only	445	594	1039	628		
GC/ECD Result only	14	415	429	457		
GC/ECD and GC/MS Result	274	223	497	497		
Total Reported Analyses	733	1232	1965 ^[5]	1582		

- [1] Two sites had no reported coordinates.
[2] Two cores were not run for PCB analysis.
[3] Field duplicates represent duplicate samples, not duplicate sampling sites and therefore are not included in the site summary.
[4] On average, three samples were obtained from each core.
[5] 83 of the samples in the Reassessment database have no reported PCB result.

**Table 2-5
USGS Flow Monitoring Stations**

Station	Station No.	River Mile	Period of Record in the Database	Drainage Area at Station (mi²)	Comments
<i>Hudson River</i>					
Hudson River at Hadley	01318500	-230	1976-1993	1,664	
Hudson River Near Corinth Below the Sacandaga River		-225	1921-1993	-2,719	Created by summing flows measured at Hudson River at Hadley and at Sacandaga River near Stewarts Bridge
Hudson River at Fort Edward	01327750	194.5	1976-1993	2,817	
Hudson River at Schuylerville	01329650	181	1977-1979	3,440	
Hudson River at Stillwater	01331095	168	1977-1993	3,773	[1]
Hudson River at Waterford	01335754	160	1976-1993	4,611	[1]
Hudson River at Green Island	01358000	154	1946-1993	8,090	[2]
<i>Tributaries</i>					
Sacandaga River at Stewarts Bridge	01325000	NA	1907-1993	1,055	
Batten Kill at Battenville	01329500	NA	1922-1968	394	
Hoosic River near Eagle Bridge	01334500	NA	1910-1993	510	
Mohawk River	01357500	NA	1917-1993	3,456	

[1] Data for these stations during 1993 were qualified as estimated by the USGS. For the Phase2 investigation, flows at these stations were estimated from Ft. Edward flows and NYSDOT Champlain Canal Water Levels. See the Phase2/Flow subdirectory for 1993 data for these stations.

[2] Data for this station during 1993 were qualified as estimated by the USGS.

Table 2-6
USGS Water Quality Monitoring Stations

Station	Station No.	River Mile	Period of Record in the Database	General Water Quality Period	PCB Period of Record	Comments
Corinth	01325420	-218	1973-1990	1973-1990	--	No data 1975-1985
Glens Falls	01327600		1975-1983	1974-1979	1977-1983	Intended to provide background levels of PCBs
Rogers Island at Fort Edward	01327755	194.2	1975-1993	1975-1994	1976-1994	Samples are composites of the east and west channels
Near Fort Miller	01328730	187	1986-1990	1986-1990	1986-1989	
Schuylerville	01329650	181	1976-1990	1976-1990	1977-1989	
Stillwater	01331095	168	1974-1993	1974-1994	1976-1994	
Waterford	01335770	156.5	1969-1993	1974-1994	1975-1994	
Green Island		153.9	1975-1990	1975-1990	1978-1985	Intended to represent combined Upper Hudson and Mohawk contributions to Lower Hudson

Table 2-7
Laboratories Employed in Phase 2 Chemical Analyses

Laboratory^[1]	Procurement Mode^[2]	Parameters
Aquatec Laboratories, Inc. Div. Inchcape Testing Services Colchester, Vermont (Aquatec)	Direct	PCBs (congener-specific) - all media TOC (sediments) TKN (sediments) Chlorophyll- <i>a</i> (water column) % Lipids (biota) Abundance and Diversity (biota)
Lamont-Doherty Earth Observatory Palisades, New York (LDEO, formerly LDGO)	Direct	Radionuclides (sediments) TC/TN (sediments) TIC (sediments) Weight Loss on Ignition (sediments) X-Ray Photography
Rensselaer Polytechnic Institute Department of Earth and Environmental Science Troy, New York (RPI)	Direct	Dissolved Organic Carbon (water column) Weight Loss on Ignition (water column) Radionuclides (sediments - assisting LDEO) Total Suspended Solids (water column)
ATEC Associates, Inc. Indianapolis, Indiana (ATEC)	SAS	Grain Size Distribution (sieve - ASTM method)
GeoSea Consulting, Ltd. British Columbia, Canada (GeoSea)	SAS and Direct	Grain Size Distribution (laser particle method)
Chemtech Consulting Group, Inc. Englewood, New Jersey (Chemtech)	SAS	Total Organic Nitrogen (sediments) Total Organic Carbon (water column) Total Suspended Solids (water column) Chlorophyll- <i>a</i> (water column)
	RAS	Metals (sediments)
Midwest Laboratories, Inc. Omaha, Nebraska (Midwest)	Direct	Grain Size Distribution (sieve - ASTM method)
Cemeic Corporation Narragansett, Rhode Island (Ceimic)	Direct	Total Organic Carbon (water column suspended matter) Total Suspended Solids (water column)
Ohio State University Columbus, Ohio (OSU)	SAS	Grain Size Distribution (laser particle method)
Saint John's University Department of Biology Jamaica, New York (SJU)	Direct	Sorting (biota)
B&W Nuclear Environmental Services, Inc. Nuclear Environmental Laboratories Lynchburg, Virginia and Leechburg, Pennsylvania (B&W)	Direct	Radionuclides (sediments)

[1] Laboratory abbreviation given in parentheses.

[2] RAS - Routine Analytical Services through the USEPA CLP.

SAS - Special Analytical Services through the USEPA CLP.

Direct - Directly procured by TAMS/Gradient outside the USEPA CLP.

Table 2-8
Water-Column Transect, Flow-Averaged Sampling and Suspended Solids Monitoring Stations

Station No.	Station Type ^[1]	Location	River Mile ^[2]	Abbreviation	Alternate Reference ^[3]
1	T	Glens Falls	199.5	GF	GF Public Works
2	T,F,S	Fenimore Bridge	197.6	FB	Baker Falls Bridge, Hudson Falls, Bakers Falls
3	T	Remnant Deposits	195.5	RMNTS	Remnant Deposit 2
4	T,F,S	Rt 197	194.6	RT 197	Rogers Island, Fort Edward, USGS WQ Sta. 01327755
5	T,F,S	Thompson Island Dam	188.5	TID	Crockers Reef Dam
6	T,S	Schuylerville	181.3	SCHYLER	Rt. 29 Bridge (Below Batten Kill Confluence), USGS WQ Sta. 13229650
7	T,S	Stillwater	168.3	SW	Rt. 67 Bridge (Above Hoosic River Confluence), USGS WQ Sta. 01331095
8	T,F,S	Waterford	156.5	WTFD	Rt. 4 Bridge at Waterford, USG WQ Sta. 01335770
9	T	Saratoga Springs	NA	SS	Orenda Spring at Saratoga Park
10	T	Lock 7	193.7	LOCK 7	Canal above Lock 7
11	T,S	Batten Kill	NA	BK	Approximately 1.1 miles upstream from Confluence (RM 182.1)
12	T,S	Hoosic River	NA	HOOS	Approximately 1.8 miles from Confluence (RM 167.5)
13	T,S	Mohawk River	NA	MOH	Near USGS WQ Sta. 01357500 approximately 1.8 miles from confluence (RM 156.2)
14	T,S	Green Island Bridge	151.7	GIB	Troy, Green Island Dam, USGS WQ Sta. 01358000
15	T	Coxsackie	125	COS	
16	T	Cementon	110	CEM	
17	T	Highland	77	HIGH	
19	T,S	Mechanicville	165.4	MECH	Mechanicville Public Dock
20	S	Thomson at Lock 5 Bridge			
21	S	Coveville (shore)			
22	S	Thompson Island Pool above Snook Kill			
23	S	Snook Kill	NA		
24	S	Moses Kill	NA		
25	S	Thompson Island Pool at McDonald Dock			
26	S	Lock 2			
40	S	River Road near Coveville			

- [1] T - Transect Sampling Station
F - Flow-Averaged Sampling Station
S - Suspended Solids Monitoring Station

- [2] Water-column transect and flow-averaged station river mile values are estimated to be accurate to within a quarter mile.

- [3] Correspondence to USGS stations is approximate but should be more than sufficient for water-column data analysis. NYSDEC primary collection sites for fish are River Miles 153 and 175.

Table 2-9
Water-Column Transect, Flow-Averaged Sampling and Suspended Solids Monitoring Dates

Sampling Event		Sampling Date
Transect 1		January 29 - February 6, 1993
Transect 2		February 19 - February 22, 1993
Transect 3		March 26 - March 31, 1993
Transect 4		April 12 - April 14, 1993
Transect 5		June 24 - June 30, 1993
Transect 6		August 19 - September 1, 1993
Transect 8		April 23, 1993
Flow-Average 1		April 23 - May 8, 1993
	A1 ^[1]	April 23, 25, 27, 28, 1993
	A2 ^[1]	May 1, 3, 5, 7, 1993
Flow-Average 2		May 12 - May 27, 1993
Flow-Average 3		June 6 - June 19, 1993
Flow-Average 4		July 6 - July 20, 1993
Flow-Average 5		August 2 - August 17, 1993
Flow-Average 6		September 9 - September 23, 1993
Flow-Average 7	C1 ^[2]	December 10, 1992 - January 21, 1993
	C2 ^[2]	February 5 - February 18, 1993
	C3 ^[2]	February 25 - March 25, 1993
	C4 ^[2]	April 2 - April 8, 1993
Suspended Solids Monitoring, Study No. 1		April 5, 1993 - October 24, 1993
High Flow Suspended Solids Monitoring, Study No. 2		March 26, 1994 - April 27, 1994

[1] Two samples were taken at the Waterford Station. during this event. Each sample represents an 8-day sampling period.

[2] These samples represent weekly temporal composite samples collected at Waterford during the time periods listed.

Table 2-10
Ecological Sampling Stations

STATION NUMBER	RIVER MILE	SAMPLE TYPE
01	A 203.3	SEDIMENT, FISH
	B 203.6	FISH
	C 204.7	FISH
02	194.1	SEDIMENT, FISH
03	191.5	SEDIMENT, FISH
04	A 190.3	FISH
	B 190.0	FISH
	C 189.6	SEDIMENT, BENTHIC INVERTEBRATES, FISH
05	189.0	SEDIMENT, BENTHIC INVERTEBRATES
06	188.7	SEDIMENT, BENTHIC INVERTEBRATES
07	188.5	SEDIMENT, BENTHIC INVERTEBRATES
08	A 169.5	SEDIMENT
	B 169.2	FISH
09	159.0	SEDIMENT, FISH
10	143.5	SEDIMENT, FISH
11	A 137.2	SEDIMENT
	B 136.7	FISH
12	A 122.7	FISH
	B 122.4	SEDIMENT, BENTHIC INVERTEBRATES
13	113.8	SEDIMENT, FISH, BENTHIC INVERTEBRATES
14	100.0	SEDIMENT, FISH, BENTHIC INVERTEBRATES
15	A 89.4	FISH
	B 88.9	SEDIMENT, BENTHIC INVERTEBRATES
16	58.7	SEDIMENT, FISH, BENTHIC INVERTEBRATES
17	47.3	SEDIMENT, FISH, BENTHIC INVERTEBRATES
18	25.8	SEDIMENT, FISH, BENTHIC INVERTEBRATES
20	196.9	SEDIMENT, FISH

TAMS/Gradient

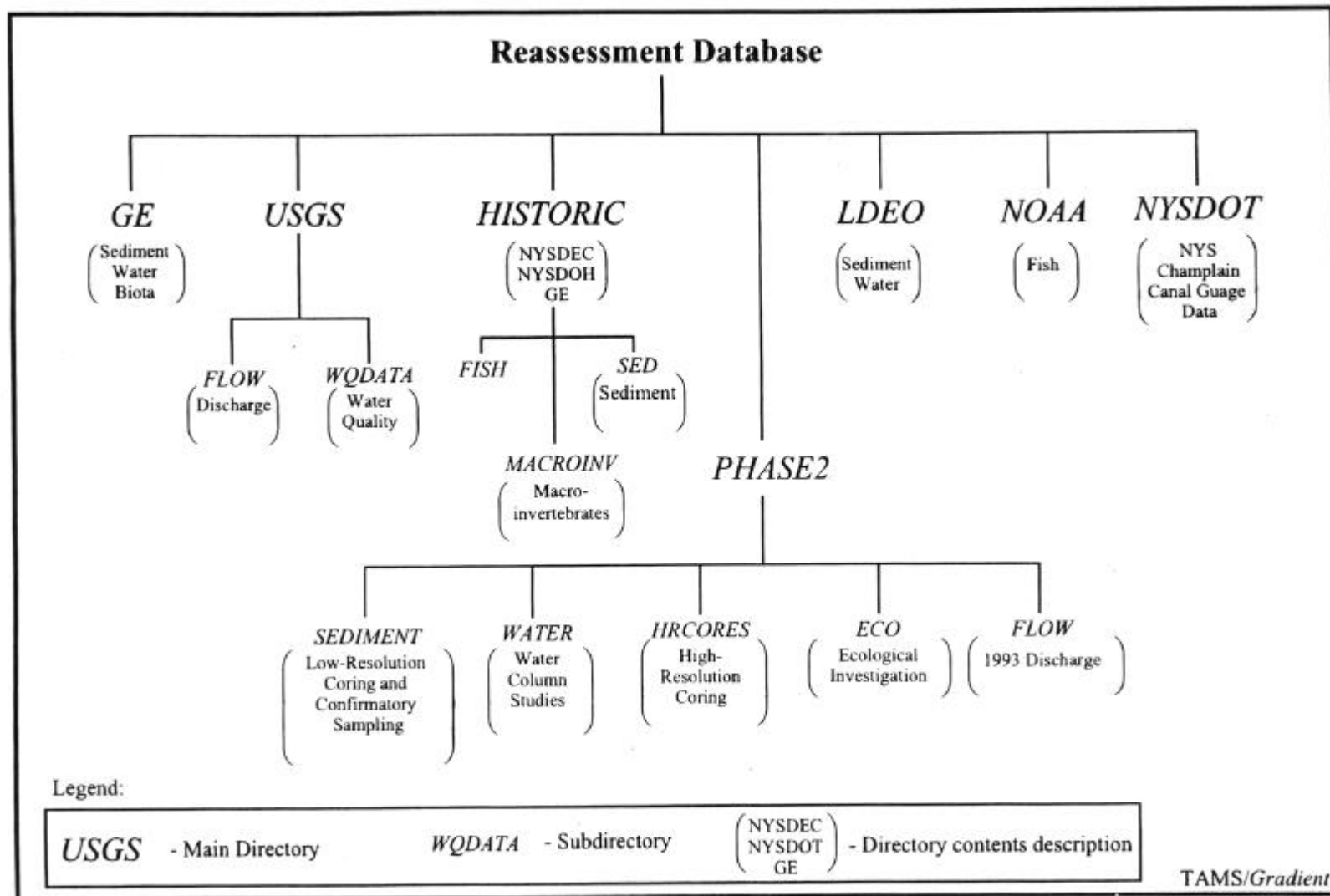


Figure 2-1
Descriptive Diagram of the Hudson River PCB Reassessment Database

USGS	- Subdirectory name
BATK.DB	- File name
(2.4)	- Section in Phase 2 Report, Vol. 2A

DISCLAIM.TXT
README.TXT

1. This subdirectory contains data from NYSDEC, NYSDOH and GE.
 2. See the Phase 2 glossaries.
- * These files provide definitions of fields and parameters contained in the corresponding directories.

December 4, 1995

Figure 2-3
USGS Monitoring Sites in
the Upper Hudson

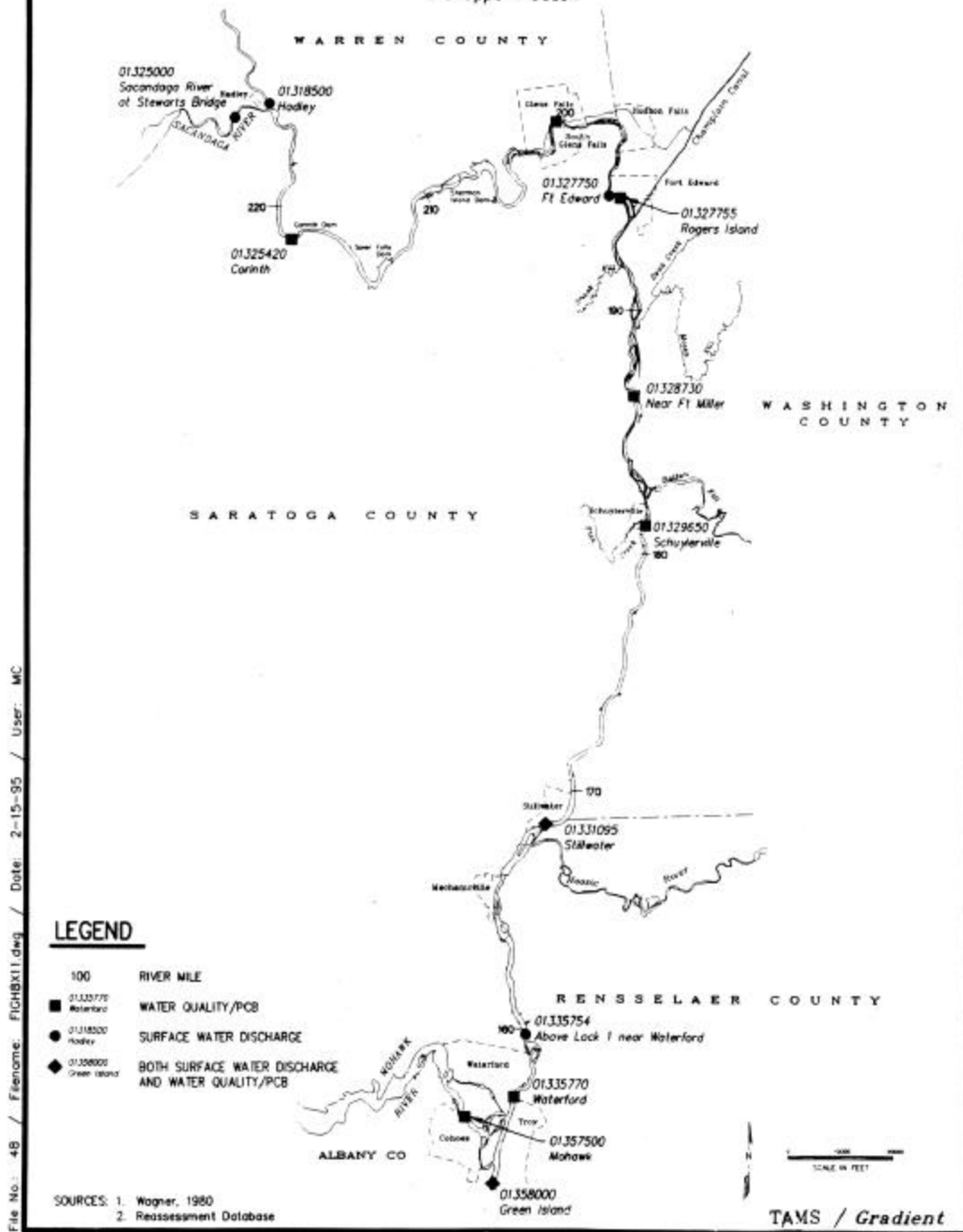


Figure 2-4
NYSDEC 1976-78 Sediment
Sampling Locations

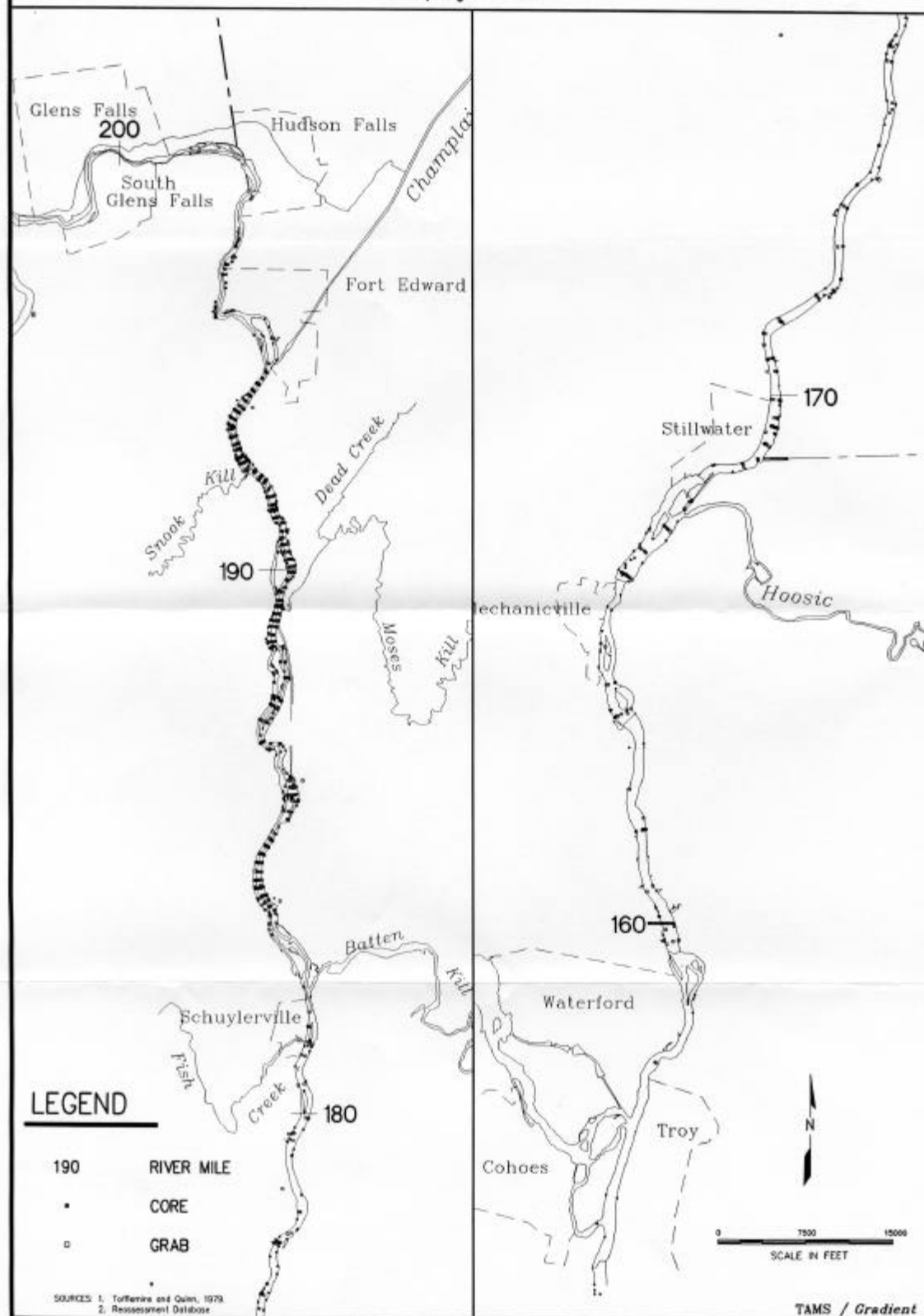
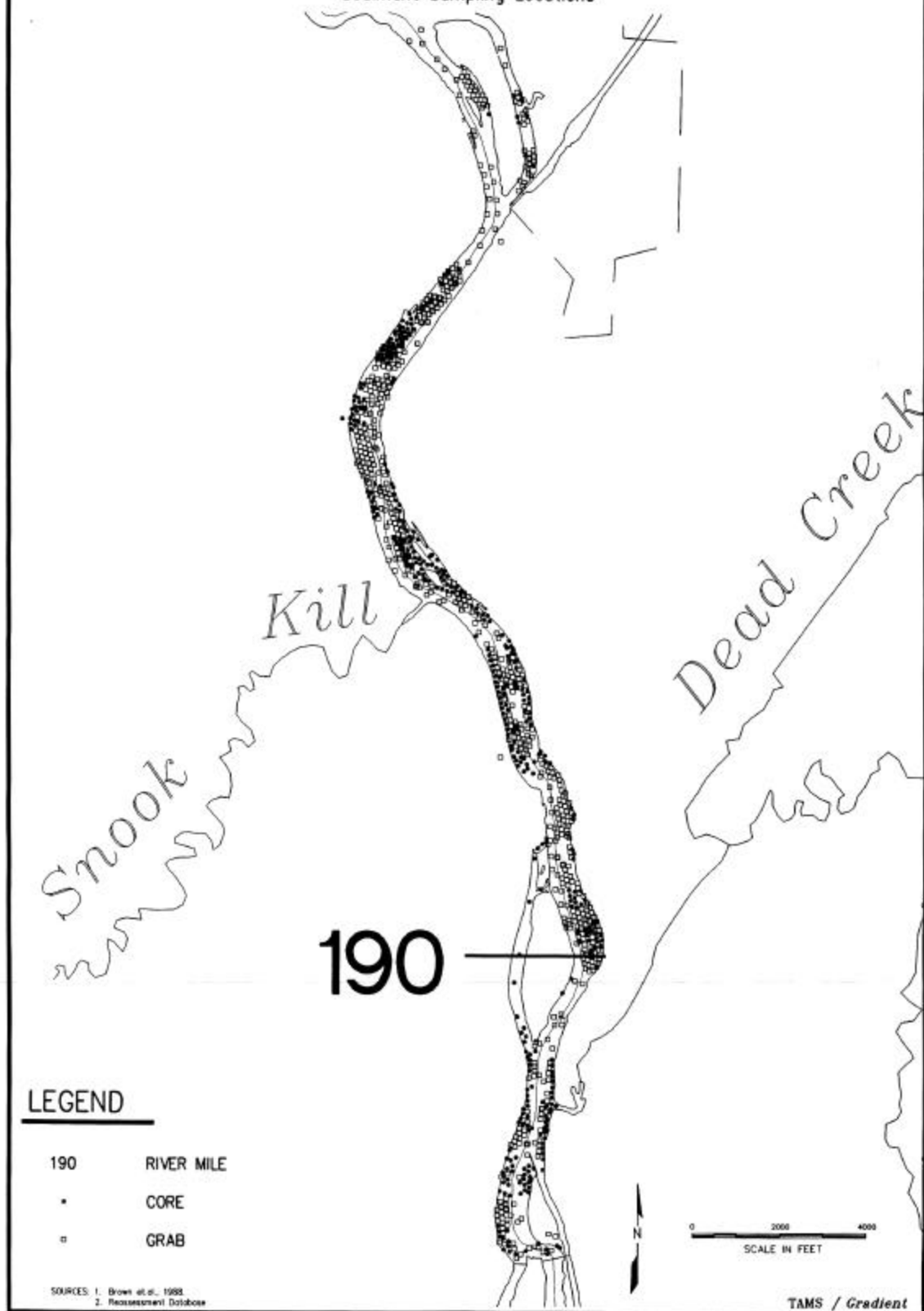


Figure 2-5
1984 Thompson Island Pool
Sediment Sampling Locations



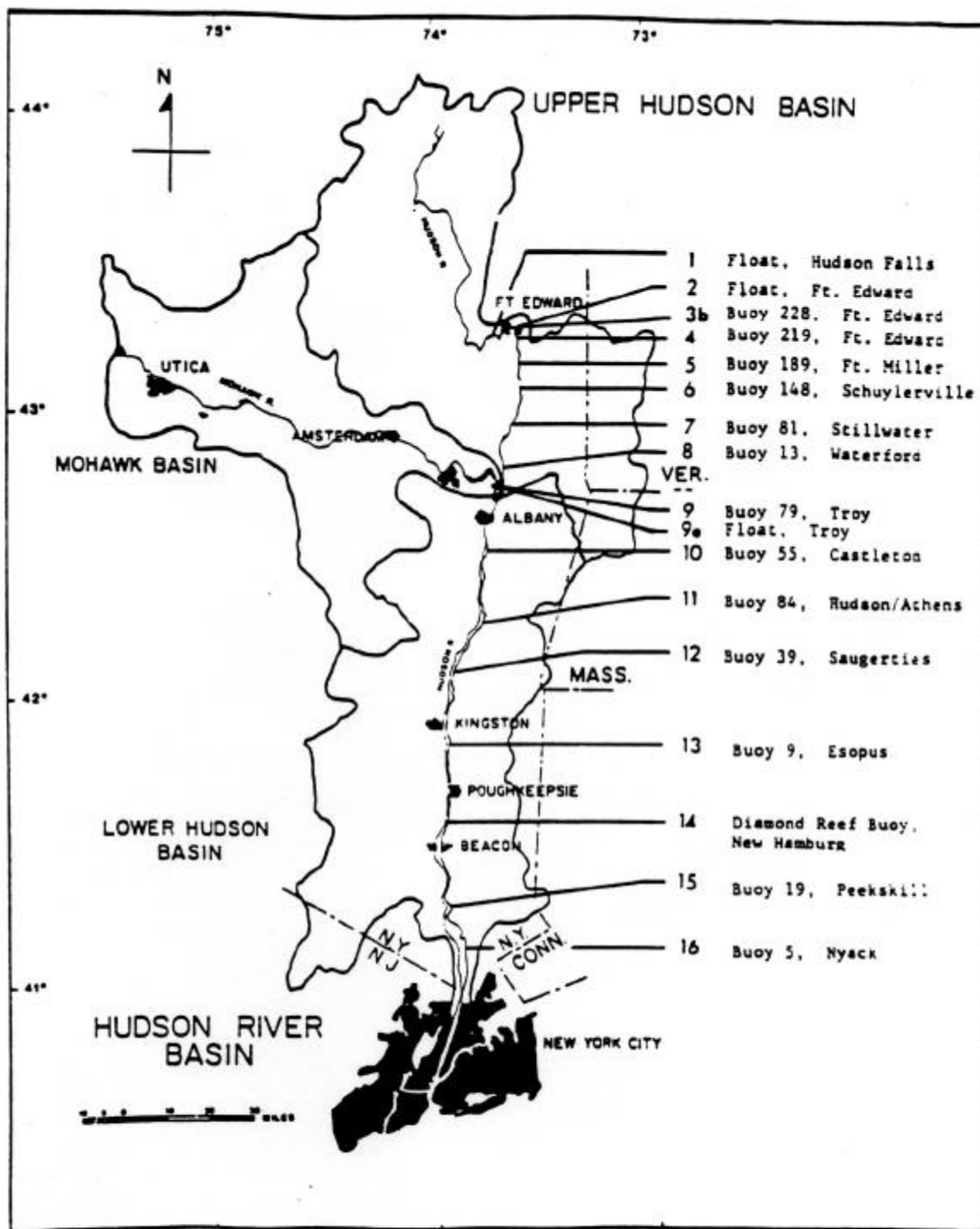
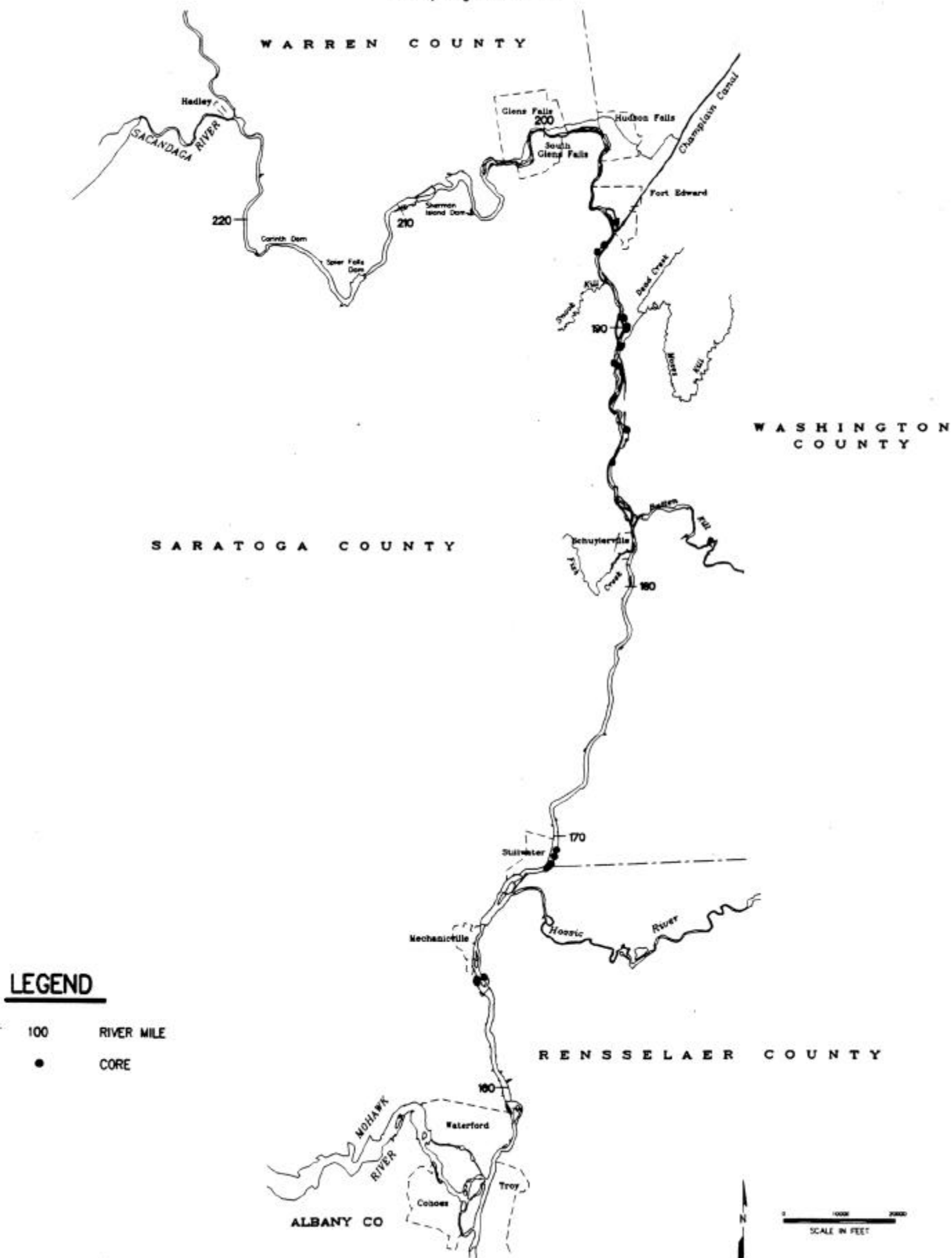


Figure 2-6

NYSDOH Macroinvertebrate Sampling Sites, Hudson River, 1978-1985

Figure 2-7
1990 GE Sediment
Sampling Locations



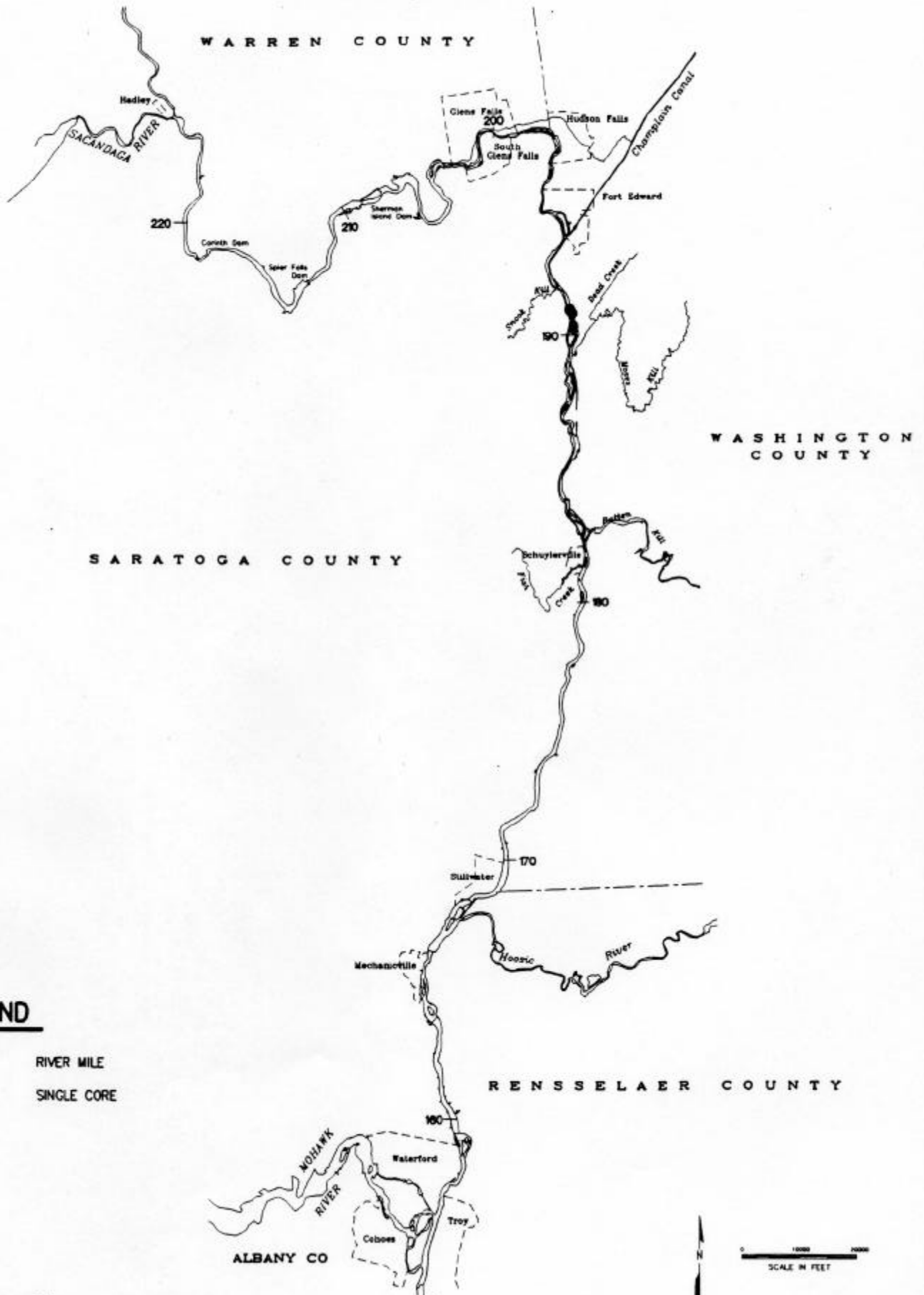
LEGEND

- 100 RIVER MILE
- CORE

SOURCES: 1. O'Brien and Gere, 1993.
2. Reassessment Database

TAMS / Gradient

Figure 2-8
1991 GE Sediment
Sampling Locations



SOURCES: 1. O'Brien and Gere, 1993.
2. Reassessment Database

TAMS / Gradient

Figure 2-9
1991 GE Water Column
Sampling Locations

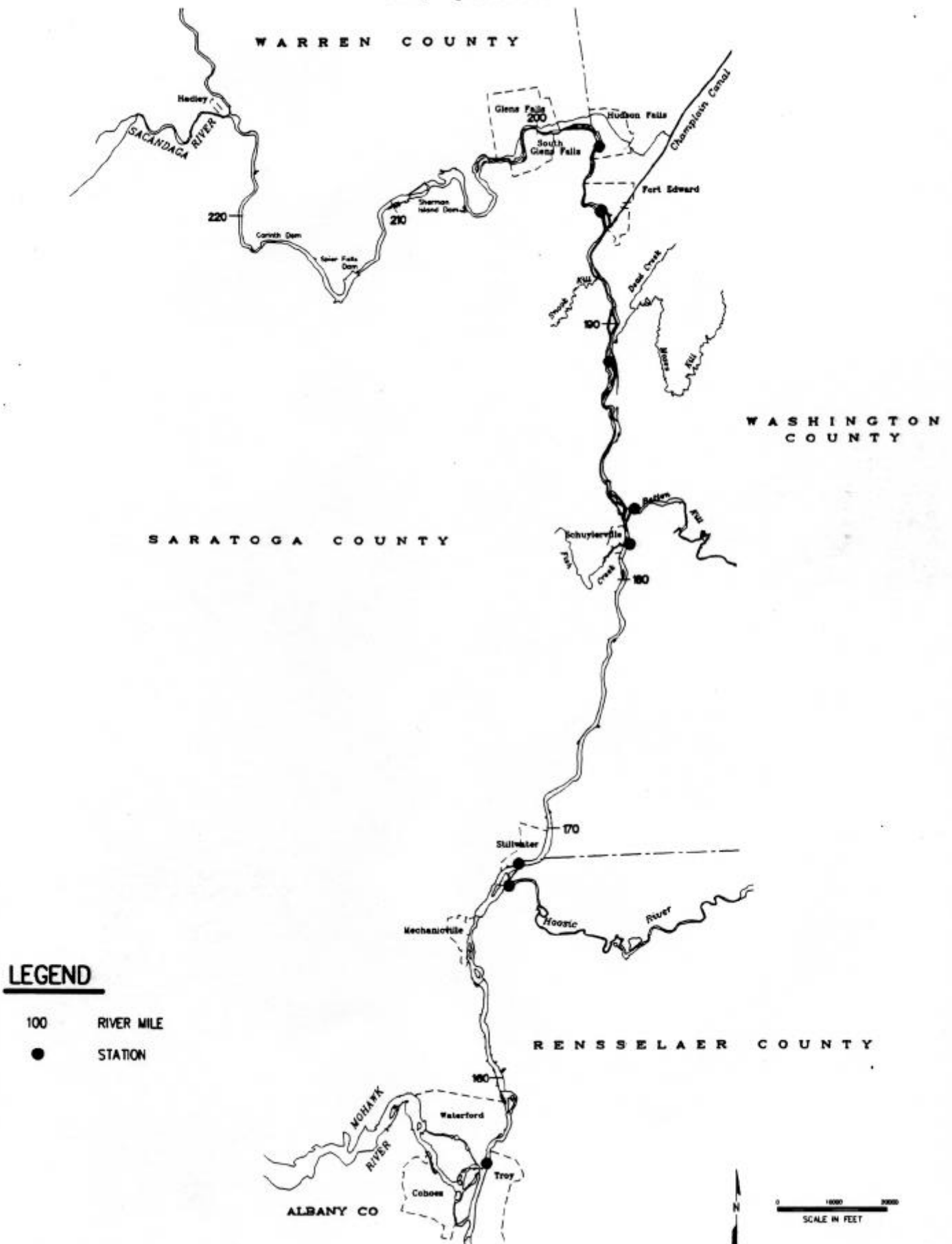


Figure 2-10
1992 GE Water Column
Sampling Locations

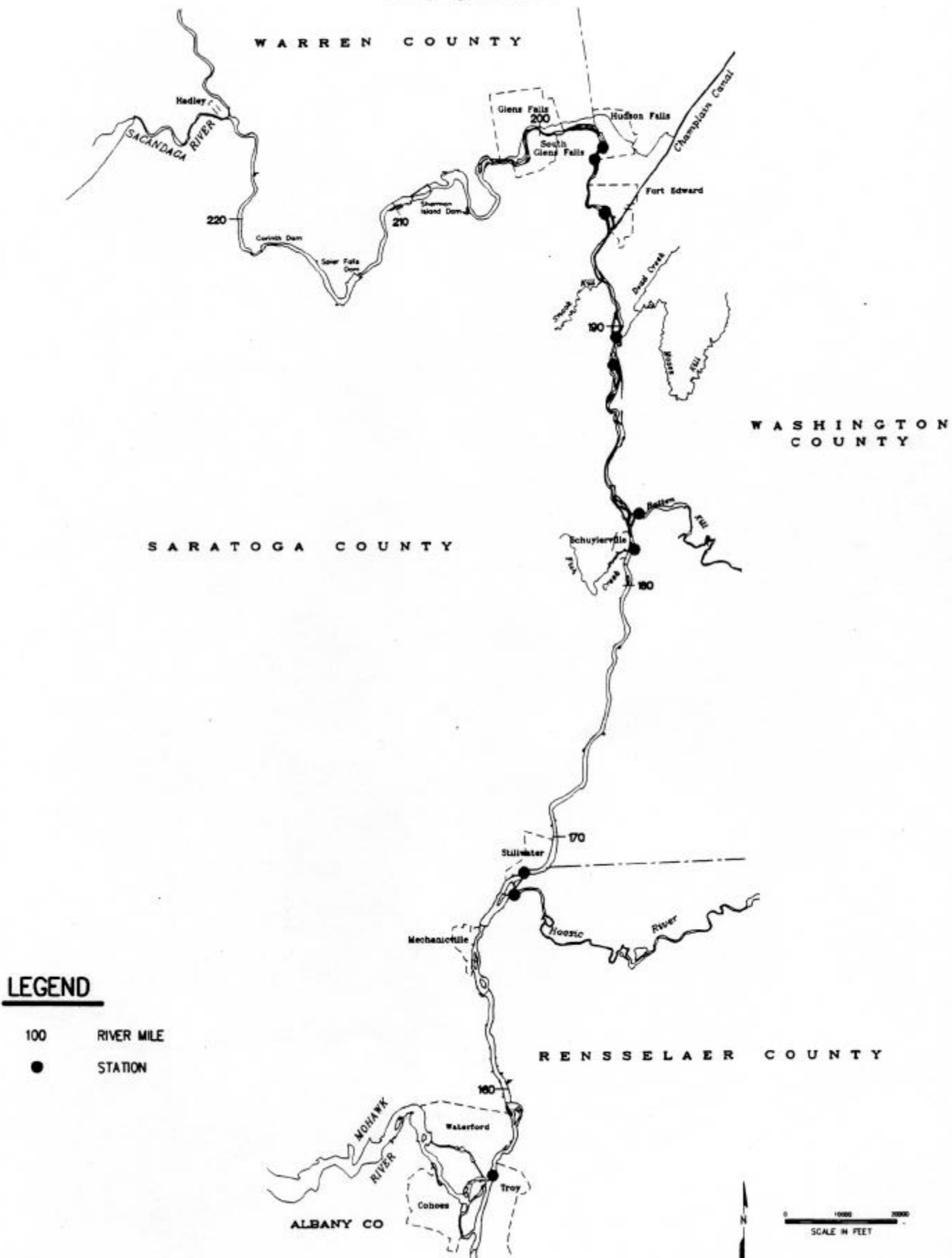
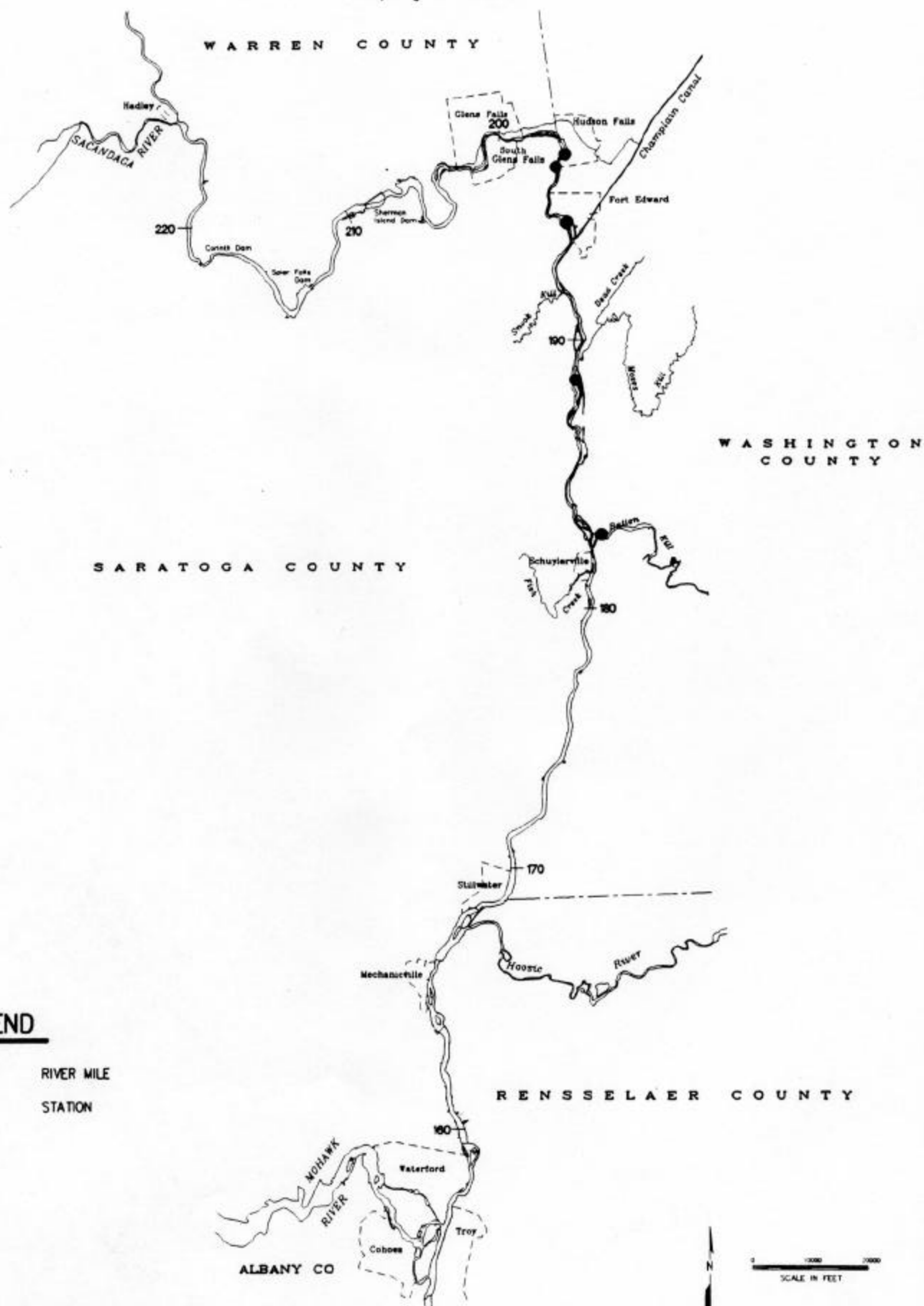


Figure 2-11
1993 GE Water Column
Sampling Locations



SOURCES: 1. O'Brien and Gere, 1993.
2. Reassessment Database

TAMS / Gradient

Figure 2-12
1994 GE Water Column
Sampling Locations

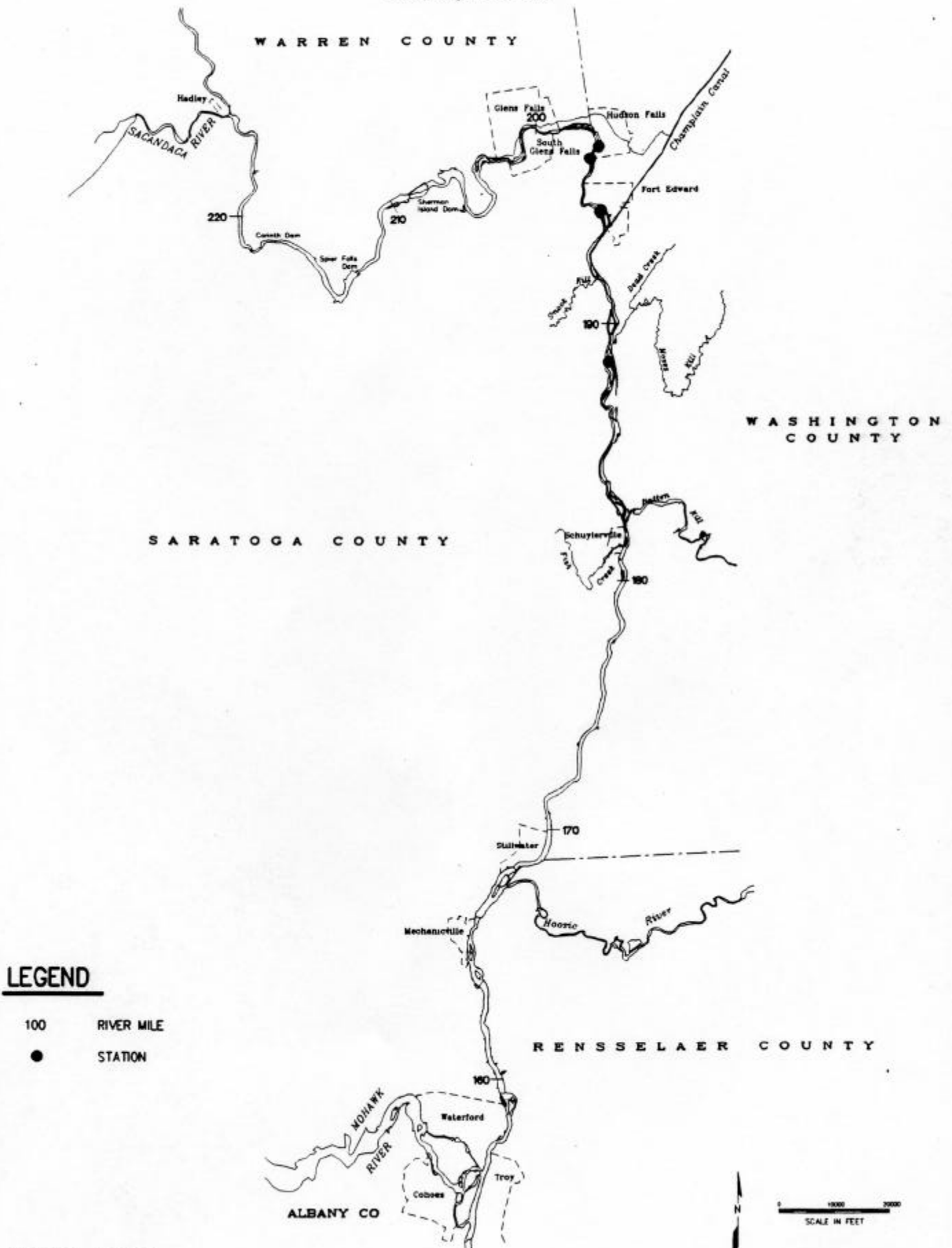


Figure 2-13A
Phase 2 Water Column Sampling Stations
in the Upper Hudson (1993)

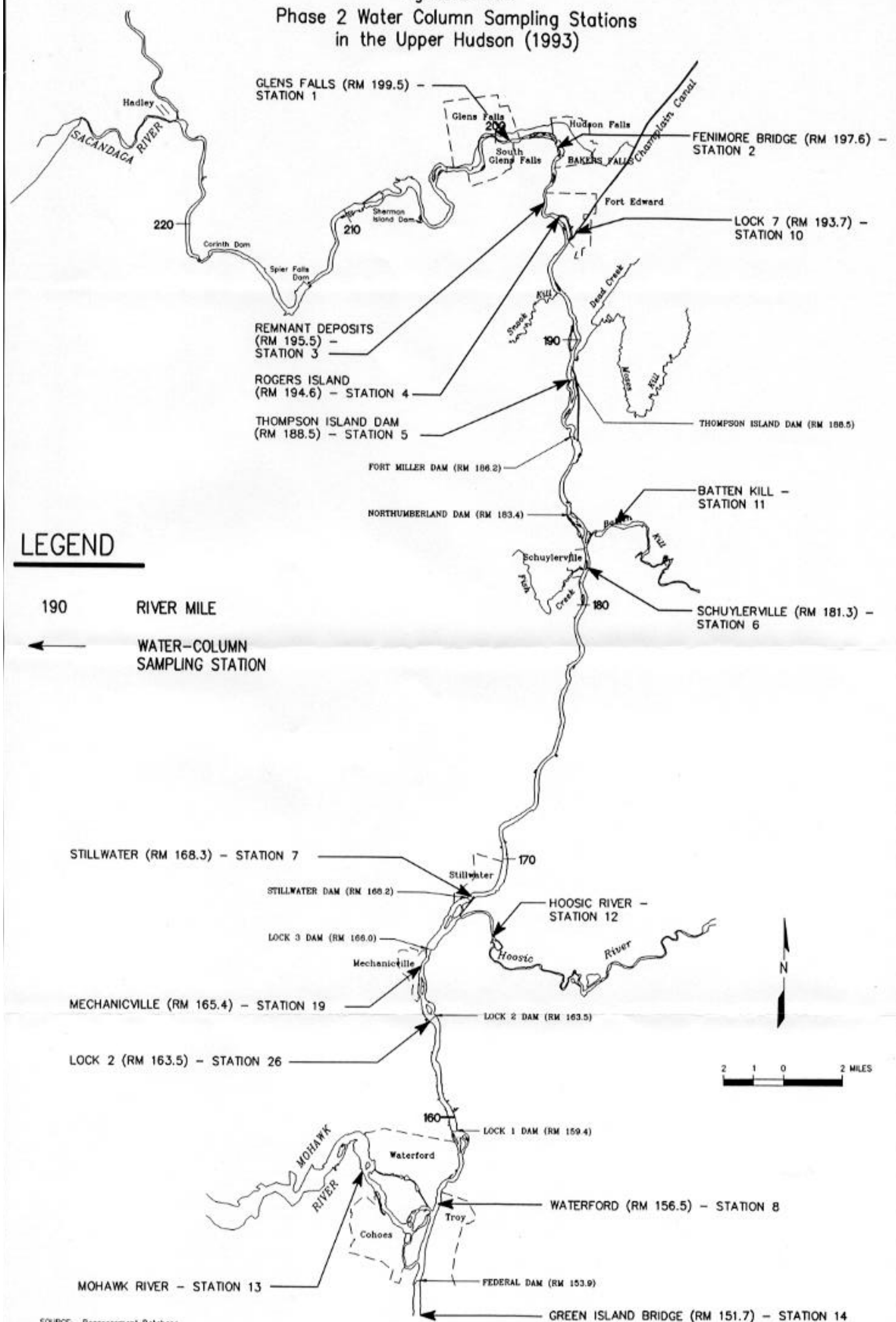


Figure 2-13B
Phase 2 Water Column Sampling Stations
in the Lower Hudson (1993)

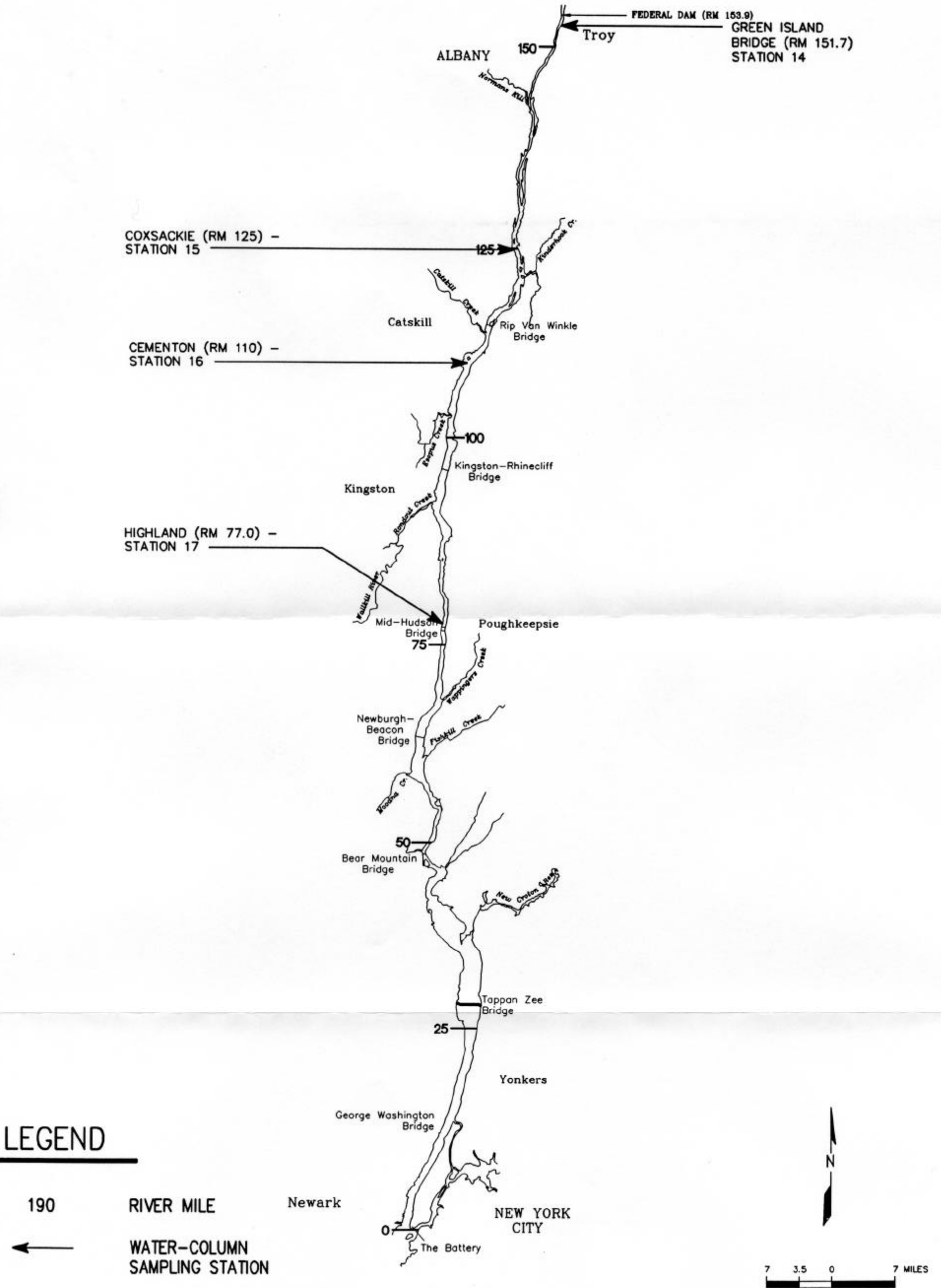


Figure 2-14
Phase 2 High Flow Suspended Solids Monitoring Stations
(1994)

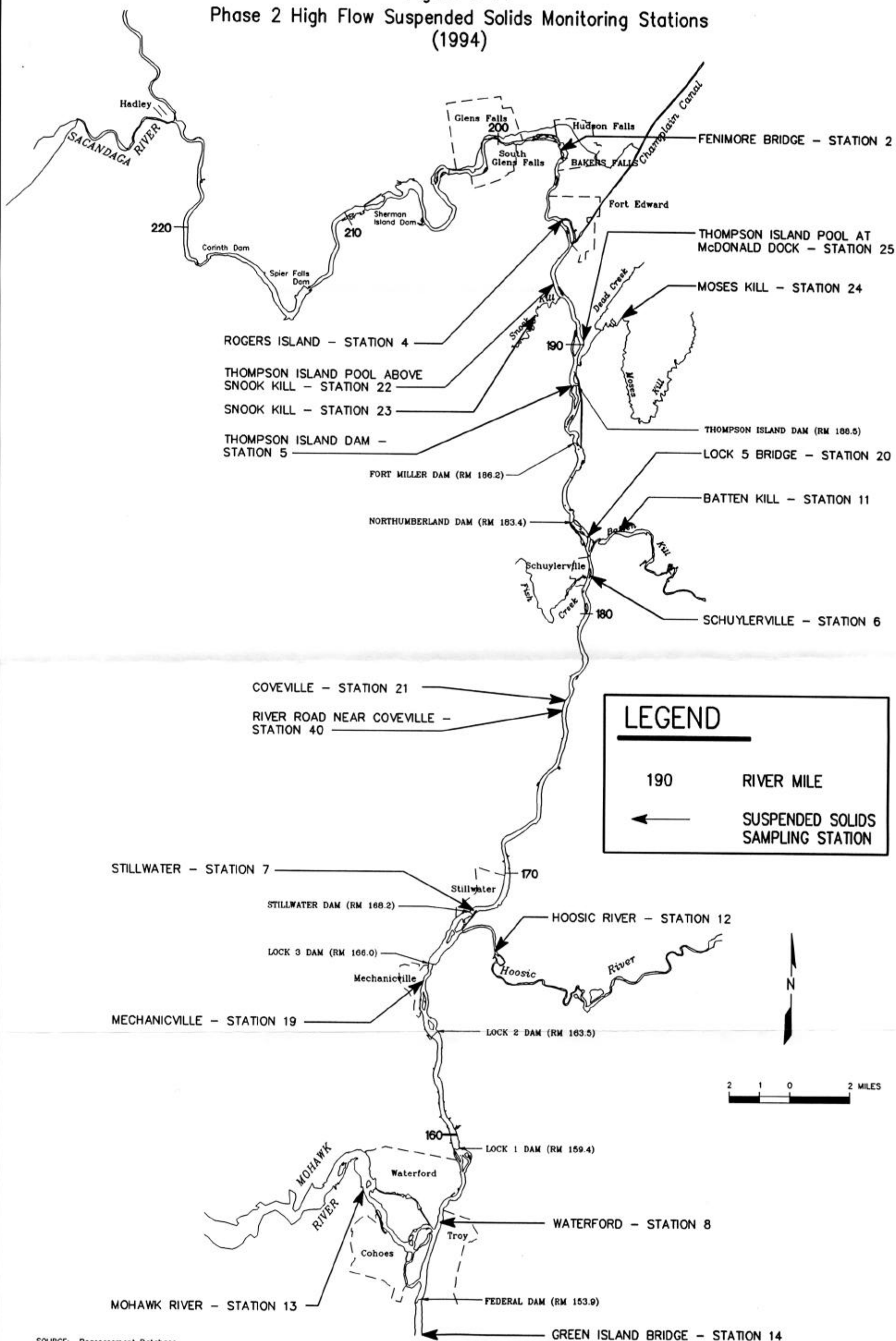


Figure 2-15
Phase 2 Confirmatory Sediment
Sampling Locations (1992)

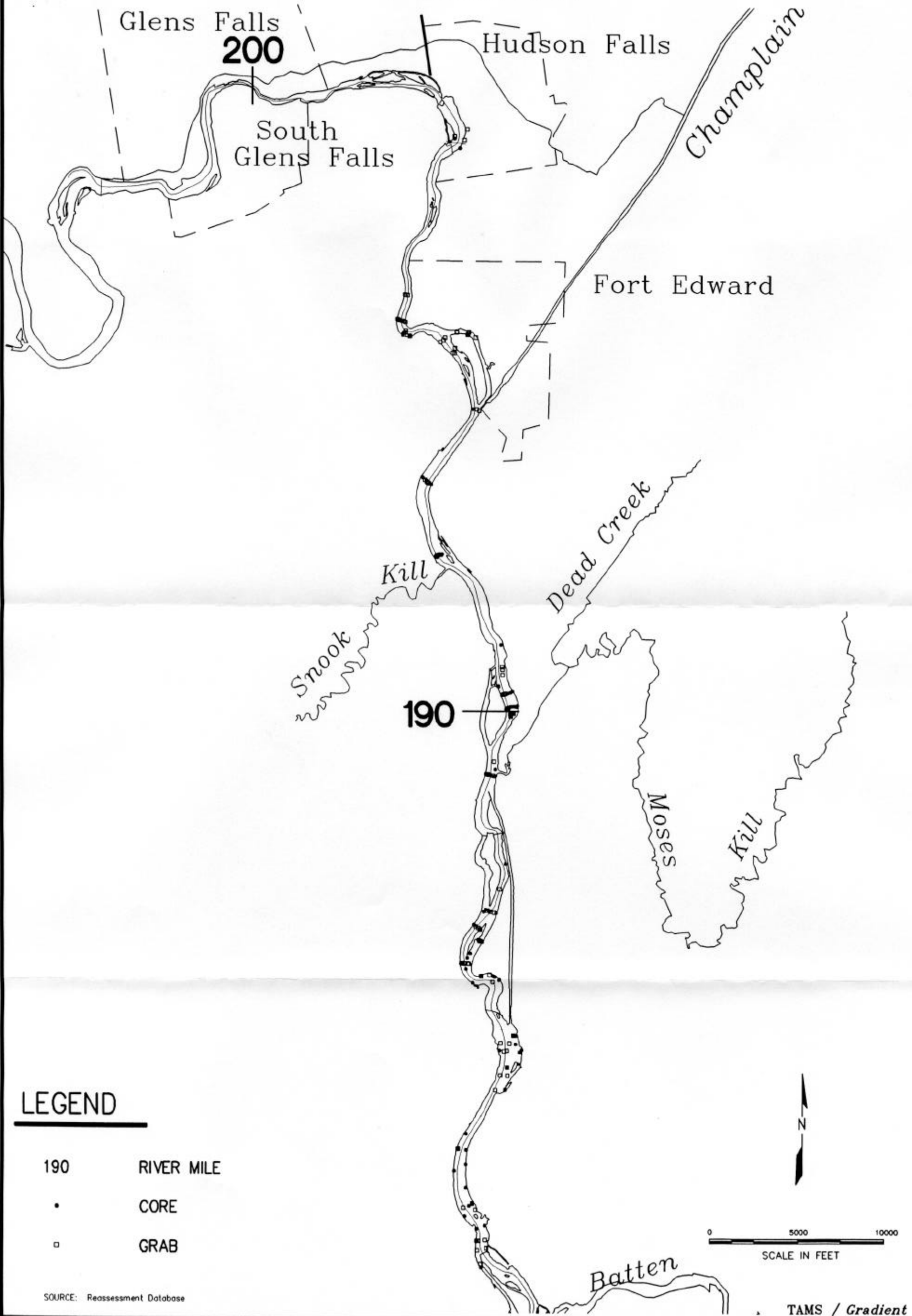


Figure 2-16A
Phase 2 High Resolution Coring Sites
in the Upper Hudson (1992)

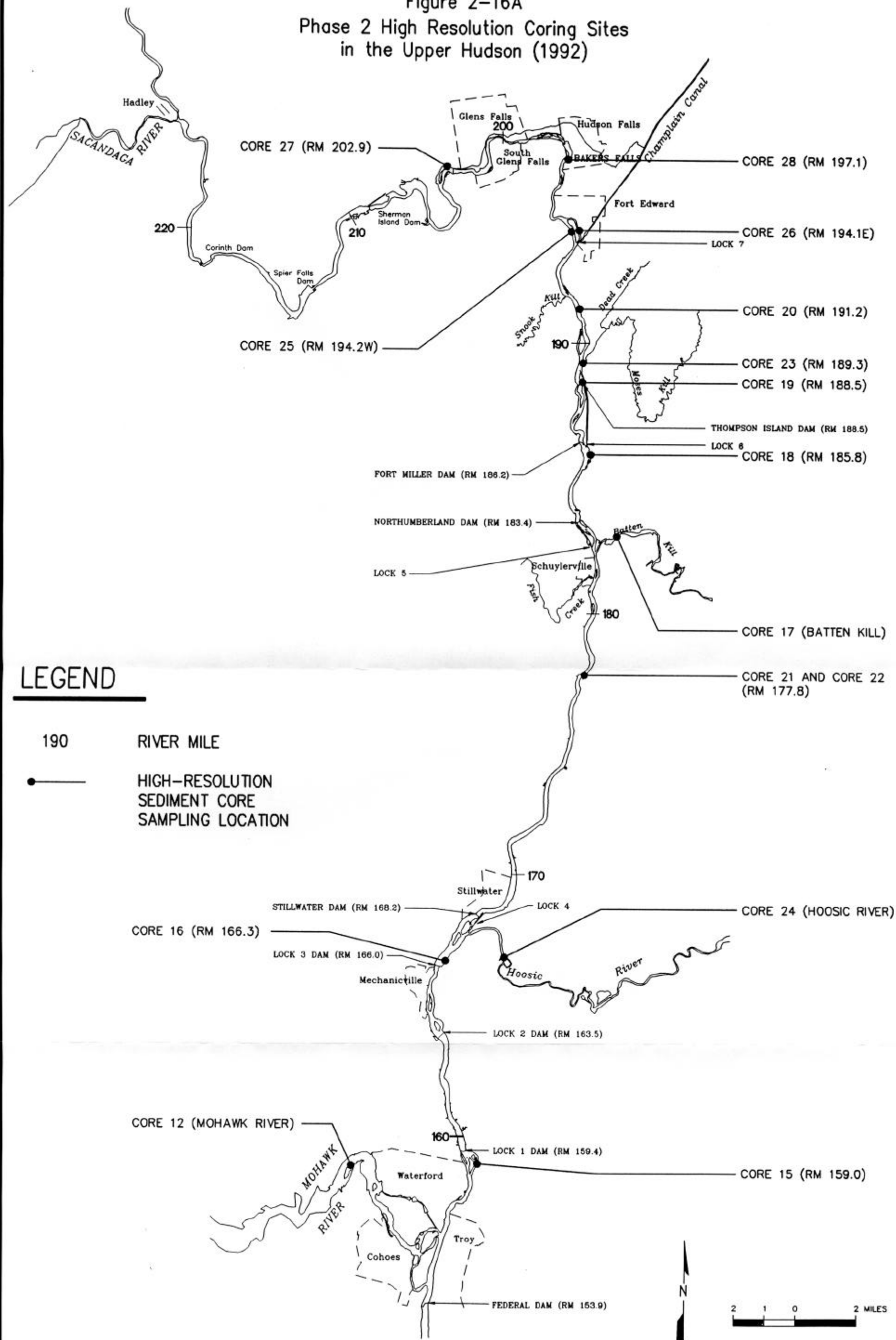


Figure 2-16B
Phase 2 High Resolution Coring Sites
in the Lower Hudson (1992)

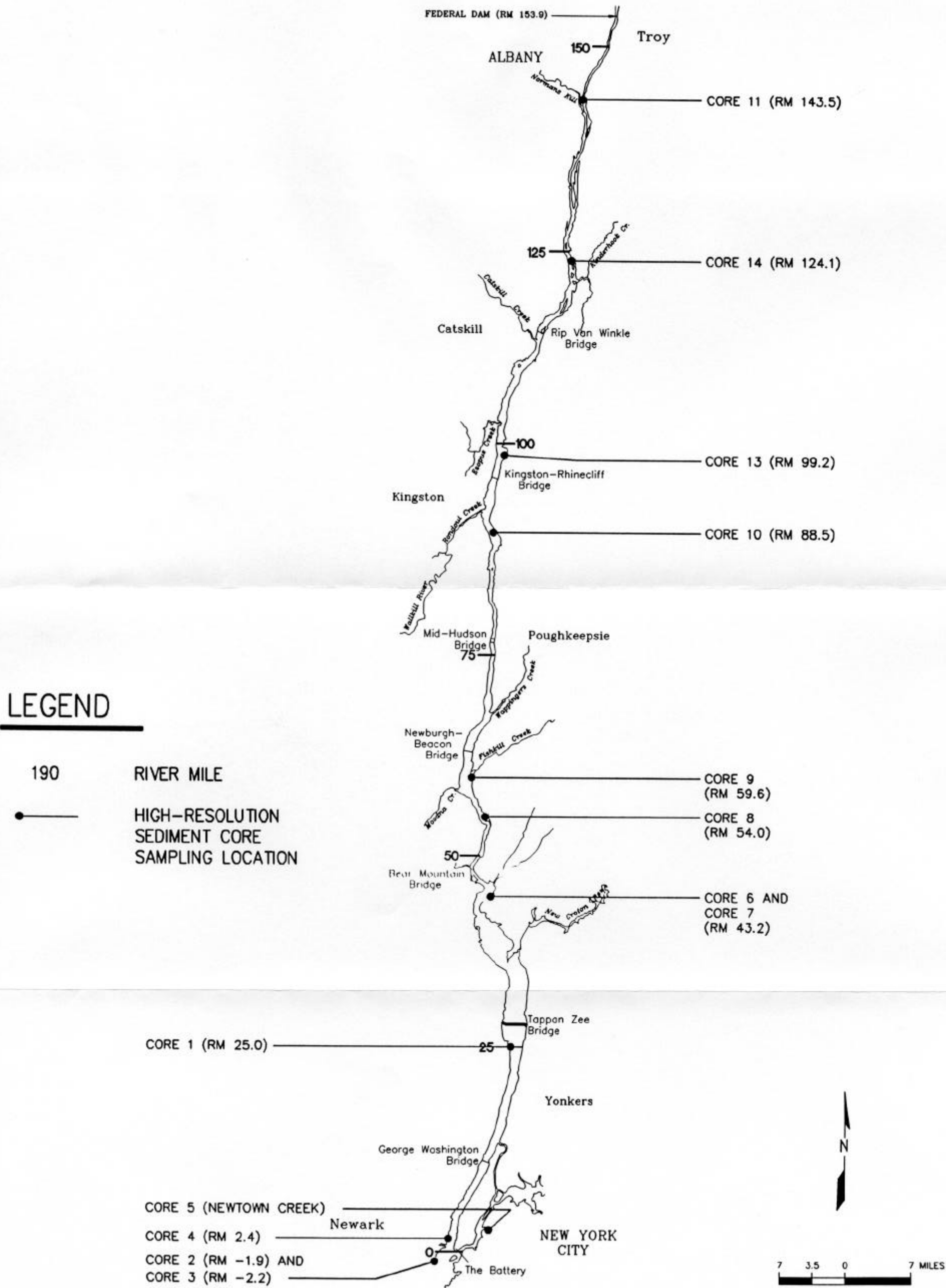
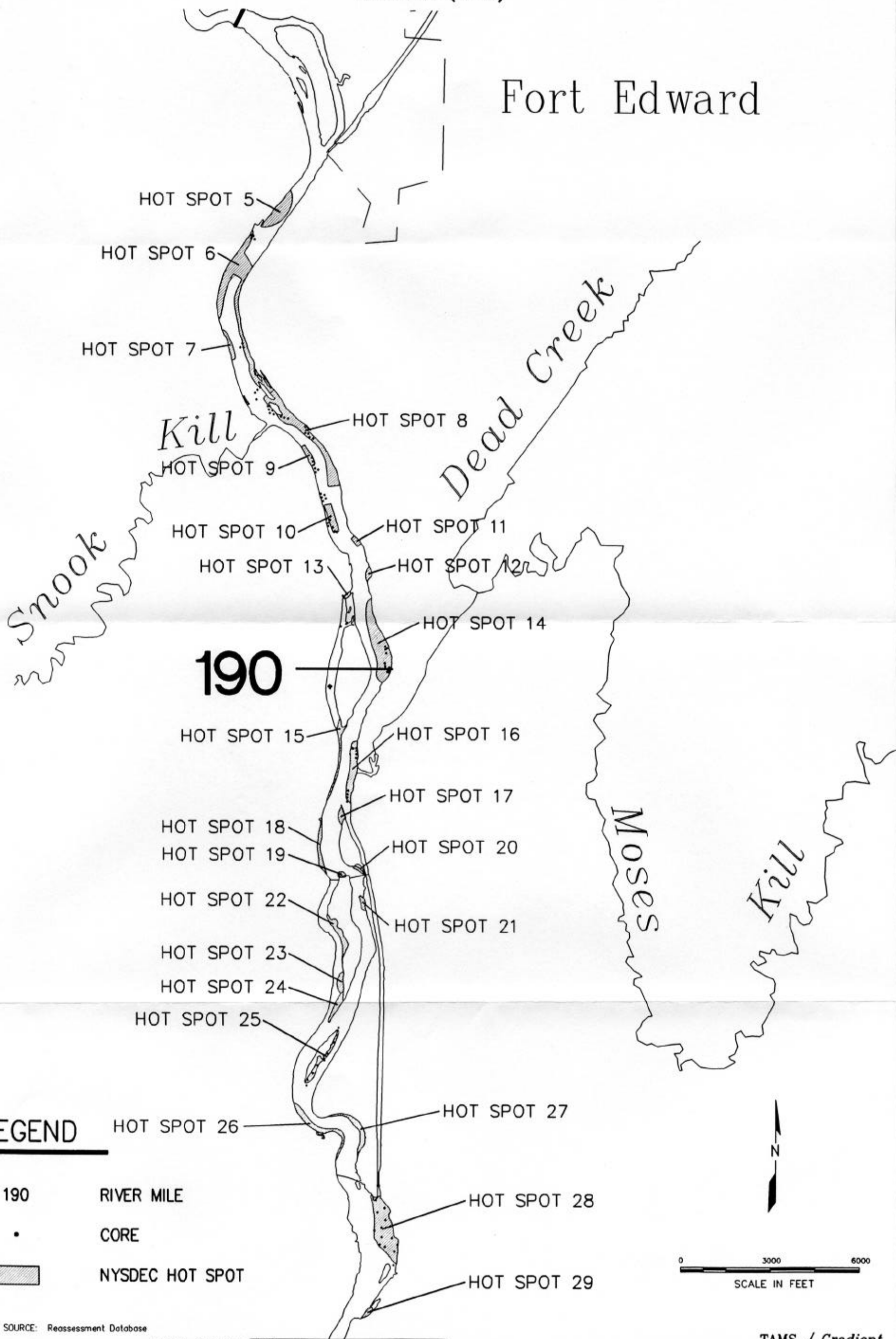


Figure 2-17A
Phase 2 Low Resolution Sediment Coring
Locations (1994)

Fort Edward



LEGEND

190

RIVER MILE

•

CORE



NYSDEC HOT SPOT

SOURCE: Reassessment Database

TAMS / Gradient

Figure 2-17B
Phase 2 Low Resolution Sediment Coring
Locations (1994)

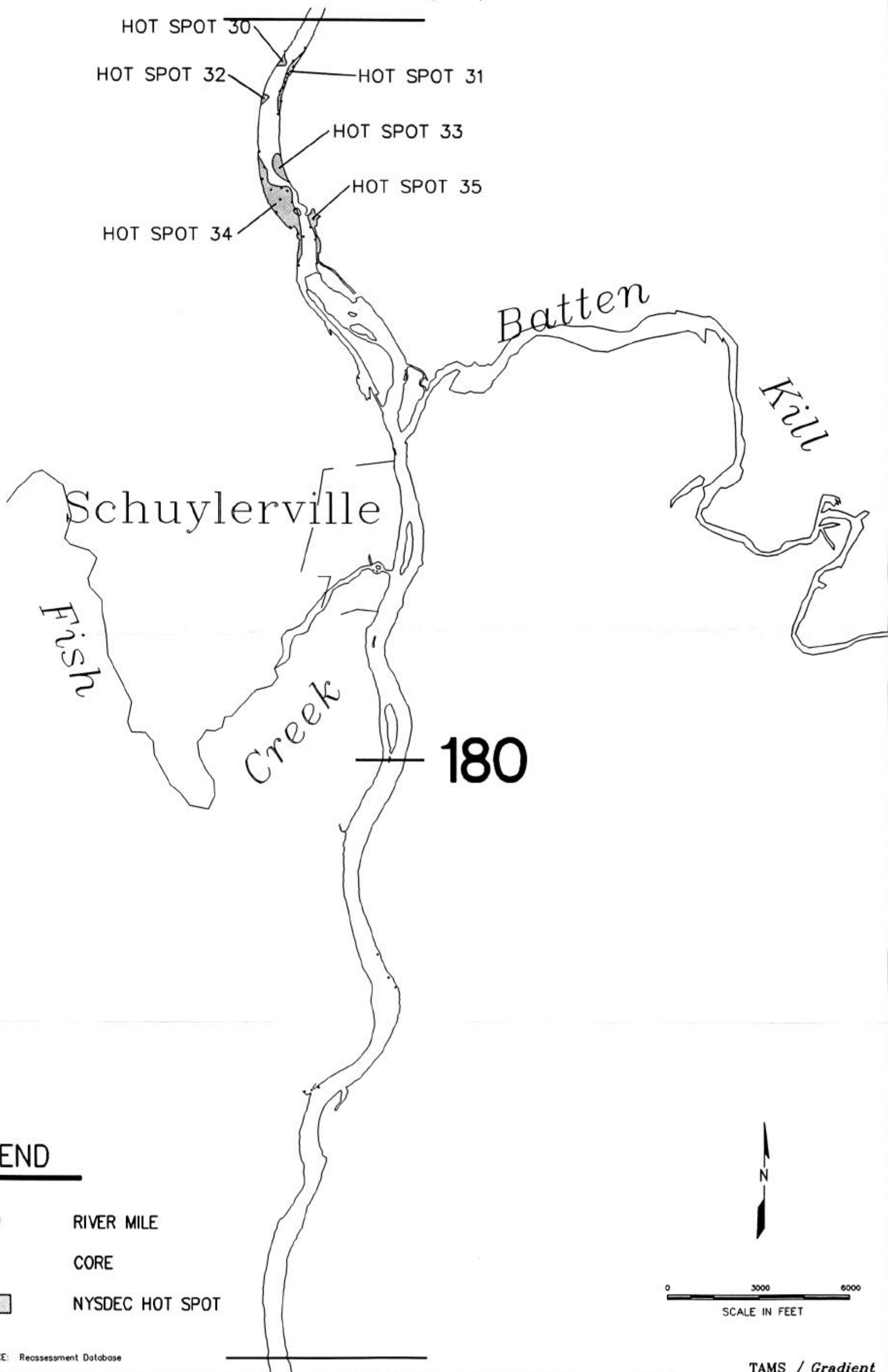


Figure 2-17C
Phase 2 Low Resolution Sediment Coring
Locations (1994)

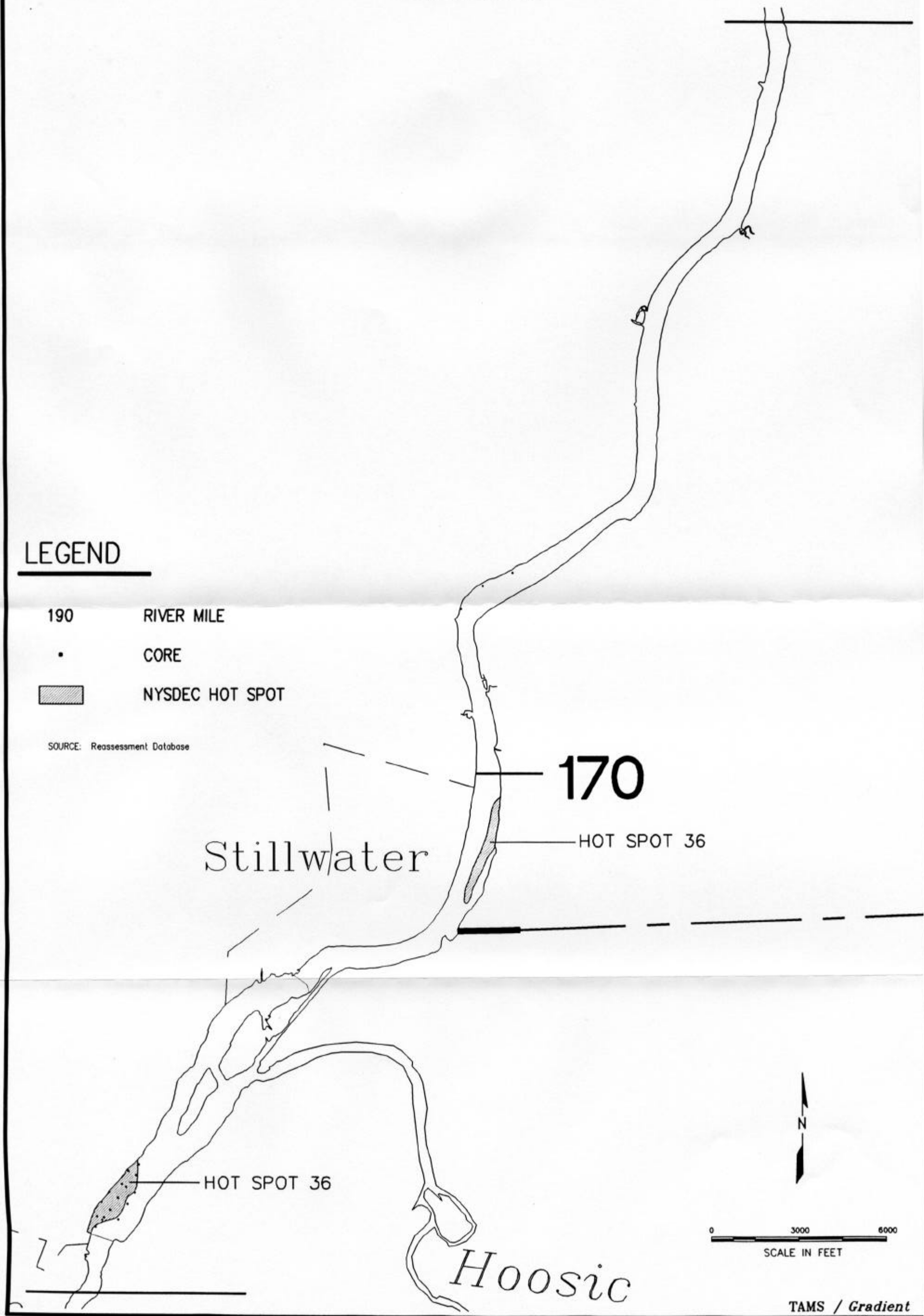


Figure 2-17D
Phase 2 Low Resolution Sediment Coring
Locations (1994)

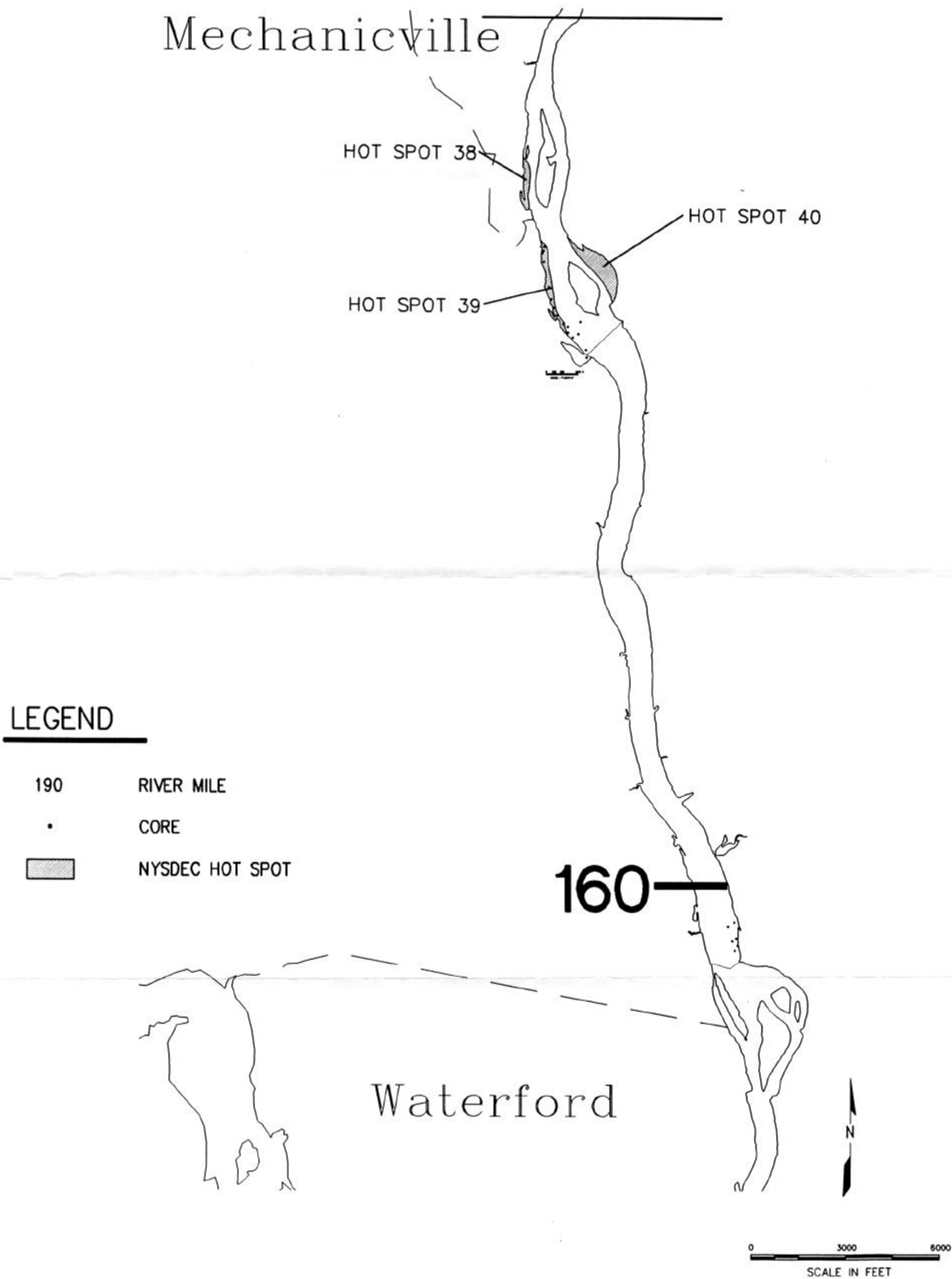


Figure 2-18A
Phase 2 Ecological Sampling Sites
in the Upper Hudson (1993)

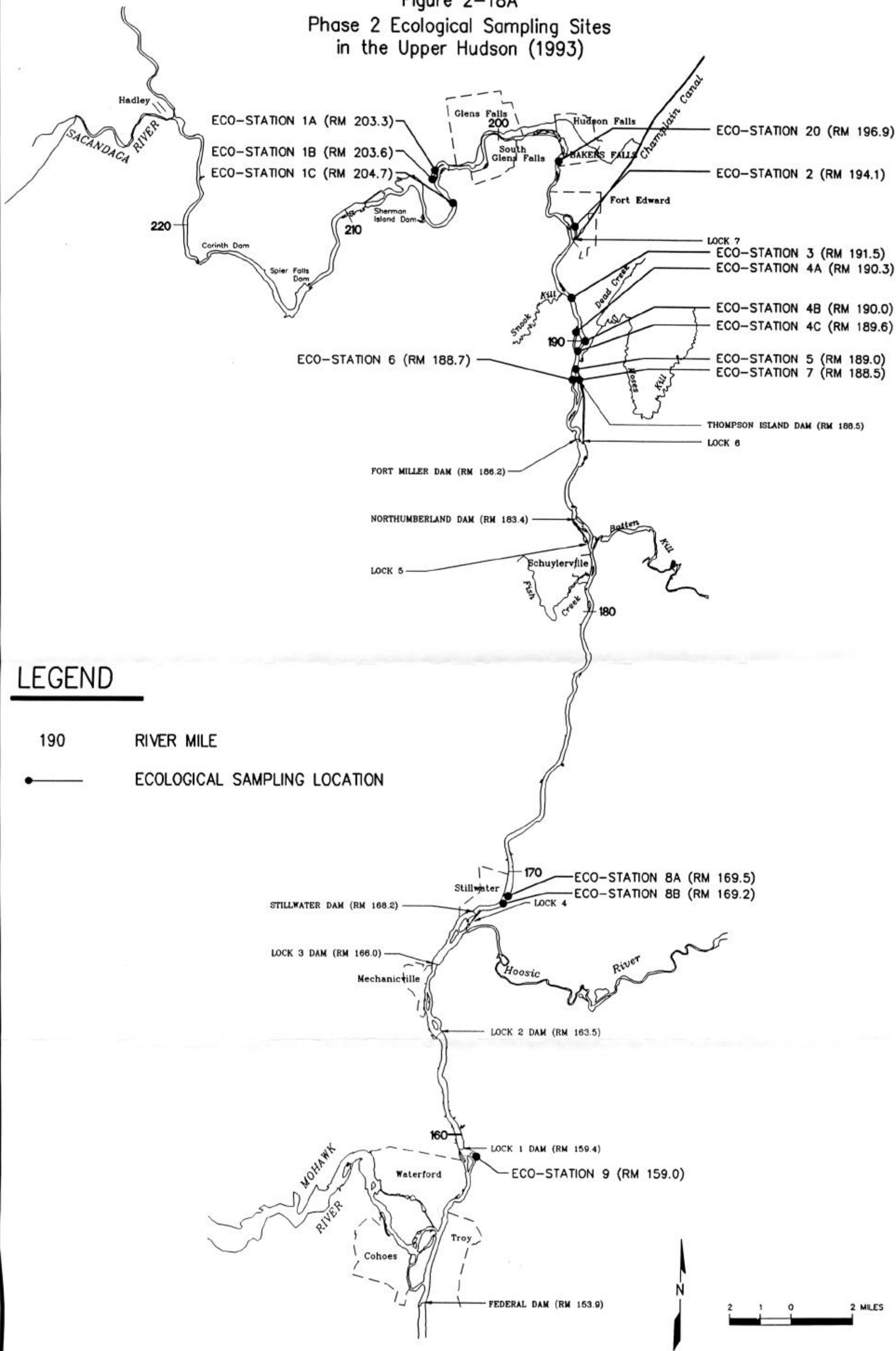


Figure 2-18B
Phase 2 Ecological Sampling Sites
in the Lower Hudson (1993)

